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VICTORIA

DEPARTMENT OF MINES.

RECORDS

OF THE

GEOLOGICAL SURVEY OF VICTORIA

(E. J. DUNN, F.G.S., Director).

Vol. II., Part 2.

ISSUED BY

W. DICKSON, SECRETARY FOR MINES, UNDER THE AUTHORITY OF THE HON. D. McLEOD, M.P., MINISTER OF MINES.

By Authority:
J. KEMP, ACTING GOVERNMENT PRINTER, MELBOURNE.

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Locality Map.

RED JASPER IN THE HEATHCOTIAN ROCKS, NEAR TOOLLEEN.

(NO. 1 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

In 1892 I delimited the Heathcote beds as far as Lake Corop, and in the following year the plan was handed in. This plan, however, appears to have been lost. While surveying this area a remarkable occurrence of beautiful red jasper was discovered. The spot was re-visited lately, and some specimens secured. The full extent of this jasper outcrop has not been determined. The outcrop is 1 mile to the east of Toolleen, on the main road to Rushworth. The red rock can be traced for ½ mile in length, and appears to be at least a chain in width; in some places it is much more. The jasper is associated with an ancient igneous rock that has decomposed into a most fertile deep red soil in which the vine would flourish. Beds of jasper, mostly yellow in colour, continue right to the top of the range. Further to the east, greenish-grey, red, yellow, and other coloured jaspers occur, but remain to be exploited. The quartz variety of cats-eye and epidote occur on this range, and there are other minerals of interest present.

Quartz veins are plentiful in some places, and where veins of white quartz traverse the red jasper the stone is very handsome.

These Heathcotian beds have proved highly mineralized in different localities. In them gold, copper, iron, and other metals and their ores have been found, but in this remarkable belt, stretching from South Heathcote to Lake Corop, little or no effort has been made to prospect for valuable metals and ores, although it presents very attractive features.

[*Report sent in 17th October, 1905.*]

SOME GOLD MINES NEAR HEATHCOTE.

(NO. 2 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Mundy Gully Mine.

The Mundy Gully mine is situated in timbered ranges about 6 miles from South Heathcote, in a direction somewhat to the east of south. The alluvial gullies a little further to the south, such as Surface and Little Surface gullies, have been extensively worked for alluvial gold. The former gully has been worked for over 2 miles in length. The mine is in a tract of auriferous country of Silurian age that extends for a mile further to the south, and is said to be traceable in a northerly direction, as far as South Heathcote, a total length of about 7 miles. At present the mine is being worked by a co-operative party of twelve, with very satisfactory results. The shaft is 240 feet deep. From the bottom level there is a cross-cut to the west. The sandstone and slate beds dip east for 30 feet from the shaft, where an eastern "leg," 3 inches thick, occurs, dipping east at 80 deg.; the pitch of the beds is 35 deg. south. At 66 feet westward from the shaft is centre-country, and at 102 feet to the west of the shaft is the western leg. The whole thickness of the country-rock

is traversed by quartz spurs. Along the level, 65 feet southward from the western leg, and in the stopes overhead, a great development of quartz has taken place on what is apparently a saddle formation. Quartz is very abundant in this portion of the mine, and is being sent for crushing from wide faces.

At the 150-ft. level in the eastern cross-cut the country rocks dip west. At 30 feet to the east is centre-country. The pitch is 20 deg. to north, and at the shaft there is a syncline.

The eastern leg is 12 feet along the western cross-cut, and the western leg about 60 feet in from the shaft. The striking feature in this level is the abundance of quartz of a profitable character. A great deal has been won here, and also from the winze below the level. Work is now being actively carried on in this level. The operations at this mine show that saddle-reefs and legs exist, as well as irregular spurs, and the results obtained by crushing large quantities of quartz are very profitable. For the last twelve months an average of 7 dwts. of gold per ton is reported. With the large bodies of quartz (as much as 30 feet across in one case) this return pays handsomely.

The official returns for the Mundy Gully mine are—

	Ore. Tons.	Gold. oz.	dwts.
To 1901	251	176	16
1901	2,991	887	12
1902	221	123	8
1903	1,744	565	2
1904	1,267	652	4
1905 (9 mths.) ...	978	384	8
	7,452	2,789	10

There is a substantial plant on the mine, and the conditions appear to warrant work on a much more extensive scale than at present. The structure disclosed augurs well for the future prospects of the several mines that are being opened up to the south of the Mundy Gully mine on the same belt of country. If this tract of auriferous country be vigorously worked it will probably result in reviving the quartz mining industry of Heathcote.

New Year's Venture Mine.

The New Year's Venture mine lies about half-a-mile south of the Mundy Gully mine. The shaft is 130 feet deep, and a drive has been made along the reef, which is stated to be from 2 to 3 feet thick, at 100 feet to the south, and 50 feet to the north. Forty loads taken from the southern drive yielded 3½ dwts. of gold per ton. Twenty loads from the northern level gave ½ oz. of gold per ton, and another crushing of 20 tons from the end of the northern level yielded 7½ dwts. of gold per ton. The shoot of gold appears to dip northward, and a shaft was sunk to the north of the former shaft, so as to cut the shoot ahead of where the last crushing of ore was got. A quartz reef was followed down from the surface to a depth of 40 feet. The reef was 3 feet thick, and it is being further opened up.

The South New Year's Venture.

This mine adjoins the New Year's Venture mine on the south side. The beds here consist of soft sandstones and slates—yellow, grey and pink in colour. The strike of the country is N. 10 deg. W., and the dip easterly; the shaft has been sunk 100 feet. A reef is being worked; at 84 feet from the surface it is 6 feet to the east of the shaft. The

quartz is commingled with slate. The country-rocks dip east at 80 deg., and pitch to the north. The reef crosses the country-rocks, and dips west. The thickness of the reef is 1 ft. 6 in. At 46 feet from the surface the reef is 10 feet to the east of the shaft, and from 2 to 4 feet thick. At the bottom level the reef is just broken into on the eastern side of the shaft. Some payable crushings are said to have been taken from this mine.

Half Moon Reef.

About 200 yards to the west of the South New Year's Venture is the Half Moon reef, which has been worked for a length of several hundred feet by means of shafts.

Dairy Flat Reef.

Half-a-mile to the west of the South New Year's Venture mine is the Dairy Flat reef, also worked for a considerable length.

New Year's Venture Extended Mine.

This mine lies ½ mile to the south of the South New Year's Venture, and its workings are the most southerly on this belt of country. A shaft has been sunk 30 feet deep in the top of a ridge, but so far no gold has been got in the quartz spurs cut through. The country-rocks appear to dip a little to west. Quartz veins occur on the surface in several places. The shaft appears to be near centre-country, and it should be continued to 100 feet, and then cross-cuts should be made to the east and west.

[*Report sent in 1st November, 1905.*]

THE WATCHEM NUGGET.

(NO. 3 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

About 8 miles S.E. from Watchem, and near the eastern boundary of the Water Supply Reserve, and within mining lease No. 5145, Maryborough, there is a ridge which trends away in the direction of Mt. Jeffcott. On the north-eastern side of the ridge, and well sheltered from the south and west, is a spot where the sand was removed by the wind during the last drought, leaving a bare spot about half-an-acre in area strewn with numerous quartz chips, pieces of white quartz, &c. Before they were removed there were also stone tomahawks, mealing stones, &c., such as are usual in the vicinity of the camping-places of the blacks.

About a chain to the north of this bare patch, and in a hollow, is another smaller bare patch, and there the nugget was found. Water is always obtainable in soaks close by. There is an excellent outlook over the surrounding plains, and the spot was an ideal one for a blackfellow's camp, and that it was a favorite spot for this purpose is testified to by the great numbers of chipped stone fragments that are scattered around.

Mr. Colbert's son, Frank, sixteen years of age, was riding over the ground on 18th August, 1904, when he saw something yellow on the ground which he at first thought was a fragment of an old straw hat. He dismounted and picked it up, and saw that it was a nugget of gold. (See plate.)

The nugget weighs 41 ozs.; it is of irregular form, well water-worn, and the quartz and ironstone that occur as streaks in it are wind-worn. The gold is of great purity. Some of the bits of quartz and ironstone that were in the nugget when found have been detached. Besides the nugget one or

two pieces of quartz pebbles bearing gold were found. There is no outcrop of auriferous rocks in the vicinity, nor is there any auriferous gravel; but there are probably thick beds of Cainozoic age below the site of the nugget.

Taking all the circumstances into account, there can be little doubt that this nugget was picked up by blacks, perhaps on the auriferous area further to the south, and that it was transported to the old camping place, and left there. The evidences of sand wear would indicate that it may have been left there a long time ago.

It is well known that the aborigines took notice of gold when in their primitive condition, attracted, no doubt, by its colour, bright metallic lustre, and its unusual weight. A blackfellow found the first recorded large nugget of gold in Australia. This was at the Summit, New South Wales, and the writer saw this aborigine shortly afterwards. In Western Australia nuggets of gold have frequently been found in situations where only human agency could have placed them, such as on the surface mud of Lake Austen, &c.

Last year, at Baringhup, a large nugget was found on the eastern side of the Loddon River, on a granite area, by a farmer while ploughing, and this also may have been transported by blacks.

[*Report sent in 1st November, 1905.*]

MAXWELL'S REEF, INGLEWOOD.

(NO. 4 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

At the surface a considerable amount of work was formerly done on a reef that appears to strike with the beds, but which really cuts across them and dips to the east. Profitable results are stated to have been obtained, and lines of reef parallel to Maxwell's reef were also worked.

Maxwell's reef—which is about a mile N.E. from Inglewood—outcropped at the surface 120 feet to the west of the present shaft. It crosses the shaft at 465 feet from the surface, and two cross-cuts are being driven eastward to cut the reef on its dip. The shaft is 780 feet deep. At 686 feet the cross-cut has been extended eastward for 75 feet. An anticline occurs 10 feet to the east of the shaft; then a sharp syncline follows, and the beds from there to the end of the cross-cut dip to the west. The reef should soon be cut.

At 766 feet a cross-cut is being driven eastward to cut Maxwell's reef. The country rocks are folded into a series of anticlines and synclines. A nearly horizontal fault or "slide" cuts right through everything at this level.

[*Report sent in 1st November, 1905.*]

THE ELIZA HILL MINE AND STEAD'S REEF, NEAR BARFOLD.

(NO. 5 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

The Eliza Hill Mine.

This mine is about 8 miles distant in a northerly direction from Kyneton and about 2 miles westerly from Barfold, and 1,650 feet above sea-level. Formerly the property was known as the Greenhill South Gold mine. The

Plate XI.

The Watchem Nugget.

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NATURAL HISTORY

quartz reef being worked was first discovered about the year 1879, by Mr. David Fraser, who related to the writer the circumstances. It appears there was an outcrop of quartz that showed no gold on the outside, but when Mr. Fraser broke one of the blocks of quartz open it was studded inside with coarse gold. The country-rocks (Ordovician) are brown and grey sandstones, mudstones, and slates. Some beds of black slate occur in places. The strike of the country is N. 15 deg. W., the dip 67 deg. S., and the pitch northward at 35 deg. The quartz reef outcrops on the top of a ridge. Its strike is N. 15 deg. E., and dip 79 deg. W. At the surface the quartz was about 4 inches thick where first discovered. In the workings it ranges from 6 inches to 5 feet in thickness. The average thickness of crushing material taken out appears to be between 2 and 3 feet. There are three shafts, the northern shaft (that now being worked) is 6 feet by 3 feet, and is 212 feet deep; the southern shaft, 179 feet deep; and still further to the south the old shaft, not now used. Altogether the reef has been opened for about 600 feet in length, and gold was got for most of the distance. The mine was worked for many years, and a great deal of stoping has been done. In the northern shaft there are two levels, one at 130 feet from the surface and the bottom level. This shaft has been sunk along the reef, and is about 11 deg. from the vertical. The pitch of the gold shoots is northerly. The most northern portion of the gold-shoot is cut in the bottom level at 40 feet to the north of the shaft. At 49 feet southwards from the shaft the ore yields 9 dwts. 5 grs. of gold per ton for a width of 3 feet, so Mr. Nicholas, the manager, informed me. At 120 feet to the south of the shaft the crushing material is 3 feet thick. The level has been continued for 151 feet to the south of the shaft. Northward from the shaft the quartz is about 2 feet thick; but it is of poor quality. The shoots dip rapidly to the north, and the best way to prospect the mine is either to sink the present shaft, for by doing so any shoots further to the south would be cut in the shaft, or by driving southwards towards them. I understand this work has been decided upon, and that the shaft is to be sunk 100 feet deeper.

The quartz is much laminated; it carries about 2 per cent. of mineral, mostly iron pyrites. In the laminæ newer iron pyrites also occur, covering the faces of joints in the quartz. The gold is of excellent quality, and is worth £4 2s. 6d. per oz. The following are recent crushings:—

Quantity crushed.				Yield of Gold.		
Tons.	cwts.			ozs.	dwts.	grs.
271	10	...	...	42	5	3·27
106	0	...	...	22	5	4·97
31	0	...	...	14	5	9·45
408	10			78	15	17.69

In the gully to the N.E. of the reef a little alluvial gold was found, but it was not sufficient to work profitably.

From the Eliza Hill mine, 11 chains southward, is another shaft 90 feet deep, apparently on the continuation of the same quartz reef. The strike of the reef is N. 10 deg. E., and its dip 80 deg. W. The reef is about 2 feet thick. Six chains still further to the south is a shaft, 105 feet deep. The quartz reef here is 1 ft. 6 in. thick, and it appears to be the Eliza Hill reef. Some of the beds of sandstone, &c., here resemble those met with at the western end of Elphinstone railway tunnel. Another shaft has been sunk on the southern side of a little gully. Some stoping has been done at these shafts. About $1\frac{1}{4}$ miles to the south of these shafts

Mr. Nicholas informs me that there are twelve shafts, which have been sunk on a line of reef about 600 feet long. This reef is called the Latrobe reef, and it may be a continuation of the Eliza Hill reef.

Stead's Reef.

About ¾ mile westerly from the Eliza Hill mine there are several shafts which have been sunk on Stead's reef. Some of these are 100 feet deep. On the little rise to the north of the whim shaft the sandstone and slate beds dip at 62 deg. to the east. The reef dips W. at 72 deg. The pitch of the country is 22 deg. to the north. In the whim shaft there are also black slates. The quartz is laminated. It is reported that in a recent endeavour to open up this reef £2,000 was spent. At present no work is being carried on here. The general strike at Stead's reef is N. 15 deg. E., and the dip westerly at 58 deg. The Western reef runs parallel to it. The beds strike N. and S., and dip 70 deg. E. on the southern side of the Whim shaft. A great deal of work has been done here. There is a good site for driving in from the west at the bottom of a deep gully; but there is not much to encourage the prospector in the present condition of this reef, though forty years ago quartz from it was yielding from 1½ to 2 ozs. of gold per ton, according to Mr. Norman Taylor's map.

Other workings occur through these ranges. In Snodgrass Gully, 8 miles northwards from Kyneton, by means of a tunnel, Mounter's reef was extensively worked. An old alluvial lead was also worked formerly.

The general features of the Barfold country appear to be that the Ordovician rocks are folded into a series of corrugations. An anticline with a very flat arch, 2 chains across, occurs at Eliza Hill. It will be of interest to note what the results will be when the reef reaches this anticline.

A great deal of the country exposed at the surface at Barfold seems to belong to a barren zone overlying what appears to correspond with the Castlemaine zone of the Bendigo series. Where the Castlemaine zone is laid bare by the folding or by denudation gold is present, but most of the country at the surface is barren of gold.

Granite at Black Hill, near Kyneton.

About 5 miles to the north of Kyneton is an outcrop of granite, that rises for 150 feet above the surrounding country. Groups of conspicuous tors are prominent landmarks for miles around. The granite consists of white felspar of one species only and quartz; these are about in equal proportions. Biotite (black mica) is dispersed freely through the felspar, but very little occurs in the quartz. The granite is of coarse texture, and not suitable for the better class of building.

[*Report sent in 20th December, 1905.*]

MINING AT STEIGLITZ.

(no. 6 on locality map.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

The once prosperous quartz mining field of Steiglitz now comes under the term "neglected gold-field," for at the present time work has ceased on all the mines except the New Mariner, where a little work is being done at and near the surface.

The reef was originally called Sailor's reef, as a sailor discovered it. While sitting on a log, he picked up a piece of quartz that showed gold. The reef was first pegged out in 1856, and worked downward from the outcrop. The outcrop of auriferous quartz, from 2 to 5 feet thick, showed for a length of 60 feet, and the quartz was very rich in gold. The strike of the reef is S. 20 deg. E., and the dip 20 deg. east. The northern end of the reef was cut off by a fault, in which was a vein of quartz known as the Black reef, 8 inches thick; it was ferruginous in character. The strike of the Black reef is N.E., and it was nearly vertical. Northward, beyond the Black reef, Sailor's reef was not traced. The southern, like the northern, termination of Sailor's reef is marked by a fault, which strikes E. 40 deg. N., and dips 50 deg. in a north-easterly direction.

At the surface the country-rocks consist of nearly white sandstones and some slaty beds that resemble the Mount Egerton beds. The strike of the country-rocks at the outcrop of the reef is E. 40 deg. N., and the dip 80 deg. N.W. The country has an abnormal strike, but at a short distance the strike, a little W. of N., is normal.

The whole of the country where the reef cropped out is shattered and faulted, and along these lines of fracture quartz veins have formed. From the surface the reef was worked to a depth of about 300 feet, and good returns were obtained by the original owners. Later on a new company was formed, and the ground was worked under the present name of the New Mariner Company. The shaft was sunk to its present depth of 606 feet, and a great deal of prospecting work was done in the western country, but not a single cross-cut was driven to the east or in the direction of the anticline. As regards the existence of saddle-reefs in this mine, everything has yet to be tested. The country-rock appears to be the top portion of the Castlemaine zone, and the structure of the beds is similar to that of Bendigo, and there is no valid reason why auriferous saddle-reefs should not exist, but the work of searching for them has still to be undertaken. The main shaft at the New Mariner appears to be in fair order, and should the company re-organize, as it no doubt will, then the work of cross-cutting to the east should be undertaken, and centre-country should be sunk on, so as to test it for saddle-reefs.

Just now a little shallow work is being done a short distance S.W. from the main shaft. The country-rock here is light grey sandstone, resembling the Mount Egerton beds. A reef, 3 inches thick at the surface, but expanding to 2 feet lower down, cuts through these beds. Its strike is N. 40 deg. E., and its dip 55 deg. N.W. The quartz thickens and thins out along its course, and the shoot of gold pitches at an angle of 20 deg. to the N.E. The shaft is 23 feet deep, and the bottom of the shoot of gold cuts the shaft at 19 feet from the surface. The shoot has been worked northward for some little distance, and it appears to continue downwards, pitching north-eastward. The breadth of the shoot of gold measuring from the bottom to the top at right angles to the pitch is 15 feet.

About 40 feet to the north-west is another shaft, 80 feet deep, known as Brown's shaft. At 40 feet down is a sollar, and 9 feet to the east, in a cross-cut, the reef shows; but this is under the shoot of gold which is further to the north and deeper down, if it continues in the same course as it follows from the surface. It would be necessary to drive about 30 feet north-easterly to reach the spot where the shoot would be if it continues.

In the bottom of this shaft it is stated that there is a reef 2 feet thick, but the quartz is very white and barren-looking.

At Steiglitz, in an area of barren country as regards gold, an outlier of productive rocks is exposed, and it is on this area that the various mines are situated. The contrast between the harsh, hard, brownish, sandstones, &c., which constitute the general mass of barren beds, and the softer, more readily decomposable sandstones and slates, tinted red, yellow, and grey, of the productive beds is very marked. As these productive beds appear to correspond to the Castlemaine zone, there are good reasons for hoping that the present deplorable conditions of mining at Steiglitz may be only a passing stage in its mining career. In the past excellent returns were won from some of these mines, and if an effort were made, and the existence of saddle-reefs of a profitable nature were proved, then the permanency and the prosperity of this field would be insured.

[*Report sent in 4th January, 1906.*]

MORRISONS GOLD-FIELD COMMON, NEAR ELAINE.

(NO. 7 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

I have personally examined the Elaine and Morrisons gold-fields. The western portion of the area under review consists of Ordovician rocks, folded into a series of anticlines, in a similar manner to the structure at Bendigo. Several lines of reef to the east of Elaine have been opened up for very considerable lengths, and have been worked extensively. In a southerly direction these reefs have been traced into private property, and worked there in the case of the Clara reef. Actual evidence of centre-country occurs in the waste heaps of this mine; also in the heaps at the British Queen mine close by, but on a parallel anticline. Centre-country also shows at Argent's claim, just to the north of the main road from Elaine to Morrisons, and about $\frac{1}{4}$ mile from Well's store. The anticlinal lines run parallel for long distances through the country around Elaine. Southward they run under the basalt, and are thus masked. Hitherto the mining carried on at Elaine has not been such as would be most suitable for country with the structure that prevails. In fact, the folded nature of the beds, and the probabilities that saddle-reefs exist have not been recognised. So far as can be judged by the appearances the zone of Ordovician exposed at Elaine is the same as the Castlemaine zone, or a zone overlying the Bendigo zone. Properly to test this country the shafts should be sunk near centre-country, and the exploration should be along centre-country and by means of cross-cuts. Although at the present time mining is at a very low ebb, and the reefs are not being worked, the field is one that possesses many advantages, and that deserves to be tested on the above lines. Elaine is on the railway to Ballarat, and only 40 miles from Geelong, so that it is most accessible, and transport charges are reasonable. Sufficient work has been done at the surface and shallow depths to show that auriferous reefs exist, but nothing has been done towards proving whether saddle-reefs occur along the distinct anticlines; this work requires to be taken in hand. The field is a promising one, and the work done so far has been in the higher auriferous zone apparently. If such is the case, then there are thousands of feet in depth of likely country awaiting exploration at Elaine. It is apparently a field that has only been started on its career. For permanency and for persistently remunerative characters, saddle-reefs cannot be excelled, and the nature of this field is such as to encourage the hope that saddle-reefs

exist. There is direct evidence in favour of their existence at Argent's claim, about ¼ mile N.E. from Well's store. In this case the western leg has been worked for about a chain in length, and to a few feet from the surface, In August last a crushing of 13 tons yielded 23 ozs. 3 dwts. of gold, and in December a crushing of 9 tons from the same leg yielded 50 ozs. 8 dwts. of gold worth £4 2s. 7d. per oz. This quartz outcrops at the surface, within 2 chains of the main road from Elaine to Morrisons, and quite close to land which it is proposed should be cut up into blocks of 100 acres or so for settlement. The finding of both the E. and W. legs at this claim, of course, settles the position of centre-country, and the site at which a shaft should be sunk. On the opposite (S.) side of the road, a few chains distant, is a claim successfullv worked by Messrs. Argent and Martin for two years. Gold was left in the bottom as the water became too troublesome for their appliances to cope with. To the north of the race-course I was informed another party is at work on an auriferous reef. Still further north, and to the Mount Doran Ranges, the country is rich in gold. Indicators occur, and where these are crossed by quartz veins, heavy yields of coarse gold have frequently been discovered. Sitlington's leaders, worked many years ago for a few feet from the surface, yielded gold to the value of over £2,000 in a small area. I saw the class of gold got, and it ranges from 1-oz. pieces downward. This tract of country offers great inducements to the prospector and to small parties of miners to work the indicators and the shallow auriferous reefs, while for permanent mining the centre-country about Elaine is especially well suited. To allow any portion of this Ordovician country lying between Elaine and the cemetery near Morrisons to be selected would be to inflict a severe injury to mining interests.

Morrisons Diggings.

These alluvial diggings were rich in former years, and they were also extensive, but the more accessible portion of the sub-basaltic lead was worked out by means of adits driven in under the basalt. For several years past Atcheson and party have been driving under the tableland to the west of the Moorabool River to prospect for a gutter in that direction. This adit is in for a distance of 2,800 feet, and with the exception of a few hundred feet at the mouth of the adit, has been in auriferous wash. Portions of this wash have been and are being blocked out, and yield wages of about 30s. per week. The washdirt rests on an older conglomerate, and is about 1 foot thick. The gold yield is a little more than 1 dwt. per ton, and the wash would pay handsomely if it were easier to pick.

The adit has proved that a very great area of this auriferous wash underlies the tableland. It is a store from which miners can obtain at any time enough gold to purchase food and something more, and if some cheap method of working it could be discovered hundreds of men would find profitable employment. Long as this adit is, it has not cut right across the auriferous wash, and there is still the possibility of a deeper and richer run of gold-bearing gravel in a westerly direction.

The outlet of this wide-spread alluvial wash has not yet been proved, but apparently it must be through the pre-emptive right of Borhoneyghurk, running in a south-westerly direction, and leaving the pre-emptive near the S.W. corner. Such a lead would run under the basalt to the west of Meredith, and cross the Elaine line of reefs, but no work has yet been done on it. At the present time the Gippsland Syndicate is driving an adit S.W. from Stony Creek, with the object of tracing the outlet, and good prospects of gold have been obtained. Atcheson and party many

years ago worked a piece of alluvial ground under the basalt southward from Stony Creek, and got good returns; but as they were driving down the course of the lead they lost their levels, and could not cope with the water. This is doubtless the direction in which Morrisons lead escapes, and were it not that its continuation is through private property, I should recommend vigorous boring operations.

The source of the well-rounded quartz gravel that was profitably worked at Morrisons has not yet been traced. It is doubtless to the north, and a lead should exist between Mount Wallace and the Ordovician rocks to the west. This tract of country should also be bored, but it is private property.

Beneath the tableland at Morrisons a great width of auriferous gravel is found, and should a richer run be discovered many men could be employed. While the country is open there is room enough for miners to make homes for themselves, but if it be cut up and sold or leased there will be no room for them. Both at Morrisons and at Elaine an expansion in mining may take place, and as the land is only suitable for grazing, and the grass is now all duly consumed each year, there would be nothing gained by selling or otherwise alienating it, while such action would tend to hamper any expansion of mining, for which the tract in question is especially suited.

If a north and south line be drawn through the eastern boundary of the Race-course and Recreation Reserve, the richer belt of auriferous country lies to the west of it. I would, therefore, suggest that all the land to the west of that line be left as it is at present, for within that area individual miners can make a living, and occasionally obtain rich returns. Within this western tract there is a rich gold-field awaiting development, and one that is sure to be of great permanency.

If the timber be strictly preserved, the land to the east might be let for grazing purposes under section 105, *Land Act* 1901, without injuriously affecting mining interests.

[*Report sent in 20th April, 1906.*]

THE VICTORIA QUARTZ MINE, BENDIGO.

By E. J. Dunn, F.G.S., Director, Geological Survey.

The Victoria Quartz mine is situated on the New Chum line of fold. The shaft is now 4,025 feet deep, and it is to be sunk still deeper. The centre-country winze, sunk further to the east, about 240 feet from the shaft, has reached the depth of 4,154 feet. The rocks are slate and standstone, showing much iron sulphide. The dip of the rocks is W. at 65 deg.; the pitch is 20 deg. to the N. There is no indication to the eye that the rocks have been metamorphosed, but slices are being prepared to test the matter by the microscope.*

The cross-cut at 4,025 feet is being driven eastward, and is now 85 feet in length. At 142 feet along it, the cross-cut extended westward from the winze for 100 feet at the same level, will be reached. The centre-country winze is sunk 129 feet lower than the shaft and the bottom of it is 4,154 feet from the surface. Centre-country lies between the winze and the shaft.

A specimen from 4,287 feet examined microscopically showed no more alteration than the rocks from higher levels described in Records, Geol. Surv., Vict., Vol. I., Pt. 4, p. 260.—D. J. M.

At the 3,824-ft. level the winze is 226 feet to the east of the shaft. The country-rocks at the shaft dip to the west. Centre-country and a dyke occur in the eastern cross-cut at 80 feet from the shaft. There are four "backs" with well laminated quartz "legs," 3 or 4 inches in thickness, at each.

In the winze at 4,090 feet from the surface, gold was met with in spurs, and the manager states that auriferous spurs were met with to the bottom of the winze. Some of the spurs were of large size, and the shaft will be sunk to test them, as they are considered to be of payable character.

The great depth at which this auriferous quartz is found in this mine is confirmation of the evidence obtained in the New Chum Railway mine. The actual opening up of gold-bearing quartz at these depths adds enormously to the prospective life of Bendigo as a gold-field. It serves as a stimulus to the whole field, and will inspire confidence as to the stability of the gold-mining industry, and as to the vast reserve of gold which lies stored up in the reefs and spurs of quartz that seam these corrugated beds. The work being done here serves as an object-lesson and a guide not only to other parts of the State and the Commonwealth but to the whole world where similar conditions prevail.

It is now fairly well established that with such characteristics as are presented by the Bendigo field, mining of a remunerative character depends principally on the extent of the operations. Once the base of the industry has become sufficiently broad, that is to say, when a sufficient number of shafts have been sunk, and enough opening out work done to have a great number of faces in quartz, the industry will become a more regular one, and the gold supply more steady. Bendigo has reached this stage, and every shaft sunk and cross-cut driven in a reasonable manner will tend to still further buttress the gold-mining industry and to render the average return more constant.

I am greatly indebted to Mr. Mining Inspector Abraham and to the manager of the mine for much courtesy and assistance.

[*Report sent in 10th February, 1906.*]

THE GREAT SOUTHERN MINE, BENDIGO.

(NO. 8 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

The Great Southern mine is situated on the Garden Gully anticlinal line. The depth of the shaft is 1,725 feet, and a cross-cut has been driven for 90 feet to the east. The country-rocks are slates and sandstones dipping west and pitching south. At 80 feet from the shaft in the cross-cut is centre-country, and also a wedge-shaped mass of quartz that tapers out at the roof of the cross-cut, but which is some feet wide on the floor of the cross-cut. This has all the appearance of a saddle-reef, and it carries gold. This quartz is to be sunk upon at once, and its nature and value are to be tested. The country-rocks are of very favorable appearance, and are well charged with pyrites.

The lease on which the mine is situated was first taken up by an English company. It has a considerable length along the course of the Garden Gully line of reef. The company spent many thousands of pounds in erecting a substantial plant and machinery, and it sank the shaft to 1,200 feet. Some cross-cuts were also driven, and in one a saddle-reef was cut. This, however, so far as the small amount of prospecting bestowed on it went to prove, was barren. Then the patience of the shareholders became exhausted,

and the mine and plant were sold for a small sum, the present company being the purchasers. The English company did not sink a centre-country winze, and that work has not yet been done.

The present company sank the shaft to 1,725 feet, and should this present find prove profitable to work it will give a great impetus to this end of the field. The importance of the discovery of auriferous quartz in this mine lies in the fact that this is the most southern mine on the field. As conditions similar to those nearer the city prevail here, there appears to be every reason why in time equally great activity should prevail in mining. One of the drawbacks of deep mining is that there are years of persistent work ahead before a return can be hoped for, but once it is realized that, with sufficient capital to begin with, there are such good chances of success, even that drawback will not greatly retard the development of mining at this end of the field.

The shaft of the Great Southern mine is well placed, and there is every reason to expect that as sinking and cross-cutting are extended many saddle-reefs will be encountered.

I am greatly indebted to Mr. Mining Inspector Abraham and to the manager of the mine for their courtesy and assistance.

[*Report sent in 10th February, 1906.*]

CERTAIN MINING OPERATIONS AT BENDIGO.

(NO. 8 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Mr. H. S. Whitelaw is about to continue the survey of the anticlines to the southward of the block in which they were laid down by me in 1892, and I went over the continuation southward of the Nell Gwynne line with him. There will not be any great difficulty in following this line out to the south of Sheepwash Creek, but still further to the south the rock will probably run through an alluvial flat where no outcrops of rock will serve as a guide. The difficulty along this portion can be overcome by running cut the parallel lines further to the westward, and then approximating the position of the Nell Gwynne line. The same structure in the country no doubt continues on to Strangways, but the direction and amount of pitch will determine whether the auriferous zones are within easy reach of the miner or not.

Already leases have been taken up southward, as much as 9 miles from Bendigo.

On the Gold-fields No. 1 lease a well-timbered shaft of three compartments has been sunk to a depth of 53 feet, but, unfortunately, this is wrongly placed, as it is in westerly dipping strata, and near the syncline, instead of being in easterly dipping strata, and 100 to 200 feet to the east of the anticline. The shaft appears to be between the Nell Gwynne and the Napoleon lines, being some hundreds of feet to the west of the former and 250 feet to the east of the latter line. When the Nell Gwynne line is surveyed this far the correct position for the shaft can be determined.

At Bendigo, the permanent shafts should not be sunk in beds dipping westward. They should be sunk in strata dipping east, and about 200 feet to the east of the anticline, if centre-country is to be cut at about 2,000 feet in depth. This insures short cross-cuts. The pitch of the Nell Gwynne

line appears to undulate, as at intervals the richer auriferous zones are brought to the surface, and these were worked for gold in the early days of the field.

Continuing further southward on the same line, Sheepwash Creek is crossed, and the position of the centre-country can be determined for some distance still further southward; then a long alluvial flat intervenes and to the south of it are the shaft and plant of the Southern Gold-fields Company, at a distance of about 9 miles to the south of Bendigo. This company has been 11 months at work sinking in strata dipping west. The shaft is 200 feet deep. At 100 feet, in the eastern cross-cut, centre-country was cut at 10 feet from the shaft. At 145 feet deep, in the eastern cross-cut, at 18 feet from the shaft, centre-country was cut, so the manager informed me. The workings of this company are the most southern on the field. Auriferous quartz cropped out at the surface here, and was worked many years ago. The extension of the survey southward should show on which line this company is working.

Northward from Bendigo, Hustler's Consols Company is sinking to the north of the United Hustler's and Redan Company. There is a strong pitch of the strata to the northward, so that the shaft will have to be sunk to a considerable depth before the productive zone worked further to the south will be reached. Mr. Whitelaw's longitudinal section along the Hustler's line will clearly show the direction and amount of pitch, and give a good indication as to the probable depth required to reach the good zones.

In this case, sinking should be actively and continuously proceeded with, and no cross-cutting should be done until the auriferous zone is reached.

In Job's Gully at Bright's abattoirs a shaft is being sunk, apparently in search of the line of centre-country, which is 550 feet further to the west. This centre-country shows in the intersection of the streets in front of the abattoirs. The shaft is 75 feet deep, and a cross-cut has been driven 50 feet to the west.

Northward the Red Jacket Company is sinking a shaft. It is 50 feet deep and 10 chains to the south of the junction of Red Jacket and Dead Horse Gullies. Some work was formerly done here to the east of the anticline, and, apparently, payable quartz raised. There are alluvial workings in the gullies around, and as depth is attained the prospects are likely to improve, for the rocks at the surface appear to belong to the Castlemaine zone.

The Snowball Mine.

In this lease at Snowball Gully the shaft is 400 feet deep. Mr. Whitelaw informs me that a western leg has been extensively worked and is still being operated upon. The shaft is in strata dipping to west, and about 100 feet to the west of centre-country. Alluvial workings occur in this locality. The shaft should be continued.

The Lancashire Mine.

This mine is on the Lancashire line. The depth of the shaft is 305 feet to the bottom of the well. At the 130-ft. level centre-country is 135 feet to the west of the shaft; at 217 feet it is 220 feet to the west of the shaft, and at the same level, at 22 feet in the eastern cross-cut, another anticline shows, apparently the result of faulting. At a depth of 295 feet, 18 feet along the cross-cut from the shaft, there is centre-country; also at the same level at 31 feet to the west of the shaft. The country now being sunk through is much faulted, and is high up in the series. In the case of this mine it would be advisable to concentrate all energies in sinking the shaft, and not to make cross-cuts until a lower zone of country is reached.

This is the only mine working on the line of reef which runs between the Carshalton and Napoleon lines, and which was not marked on my original survey.

The sinking of shafts is an indispensable preliminary to the expansion of the Bendigo gold-field, and the more shafts sunk in proper positions the better will be the prospects for future prosperity. On the correct placing of the shafts much depends, and it is regrettable to find many instances where they are being sunk in strata dipping to west, while the correct position is 150 feet to 200 feet to the east of the anticline, and, therefore, in country dipping east. The geological survey officers might be instructed—on application at this office—to afford any reasonable assistance in locating new shafts.

In sinking, the length of the shaft should be at right angles to the strike of the rocks, or nearly east and west. In all cases it would be well for provision to be made for four compartments, one of which would need to be closely timbered and devoted entirely to ventilation.

[*Report sent in 25th April, 1906.*]

THE ARTESIAN WELL AND THE DUTSON SPRING, SALE.

(NO. 9 ON LOCALITY MAP.)

By A. E. Kitson, F.G.S.

The site of the bore is in the Market-square, near the intersection of Cunninghame and Marley streets, Sale, about 1 chain S.S.E. from the water tower, and adjoining the town baths, as shown on the accompanying plan (Fig. 22).

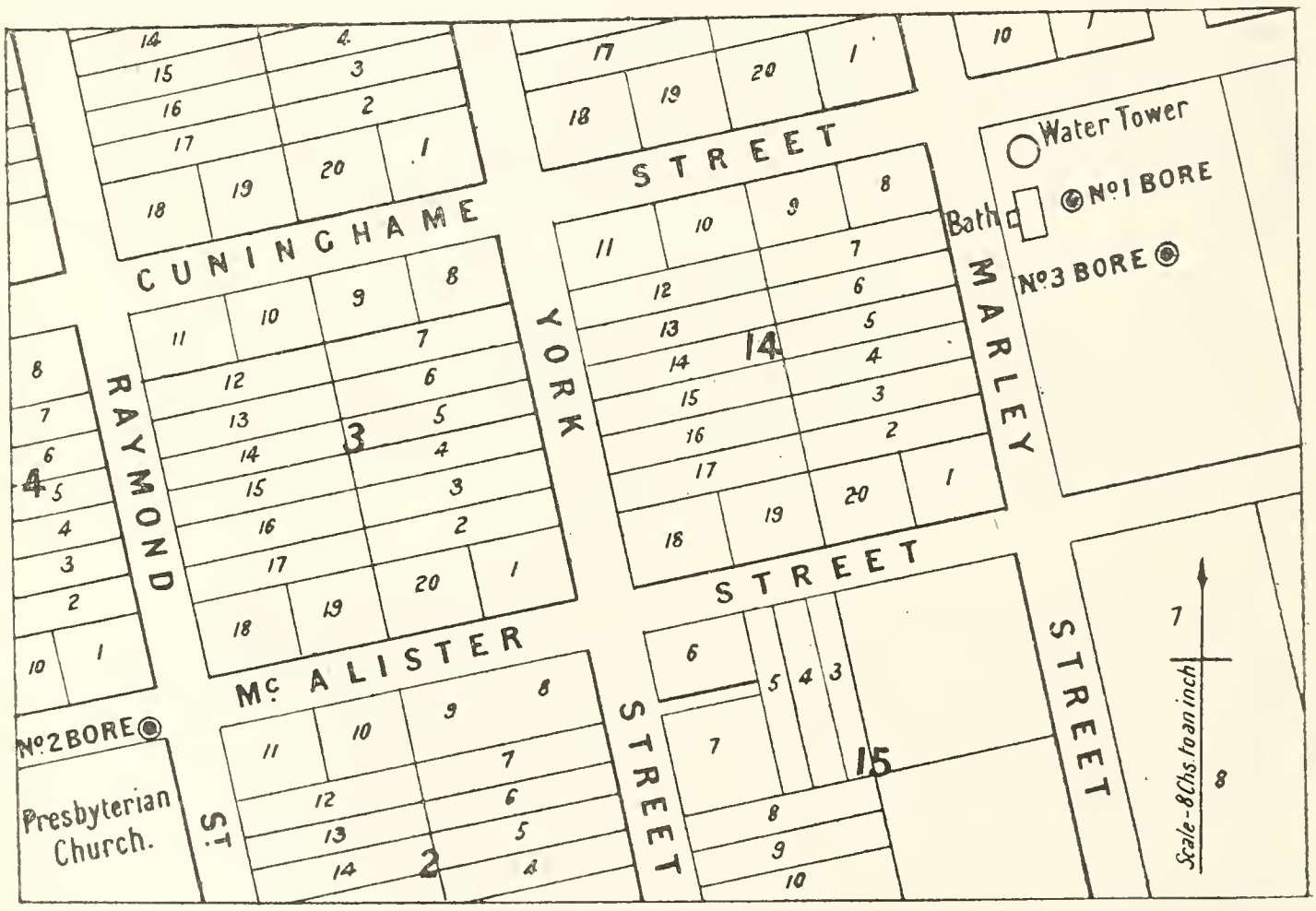


FIG. 22.

PLAN SHEWING THE POSITION OF BORES NOS. 1, 2, AND 3, AT SALE.

The bore is 10 inches in diameter, and has been sunk to a depth of 334 feet. The strata passed through, commencing at the surface, consist of the following:—

Strata.	Thickness.		Depth to bottom of bed.	
	ft.	in.	ft.	in.
Sandy clays	65	0	65	0
Fine sand with lignite	17	3	82	3
Coarse gravel	9	1	91	4
Fine to coarse sand with pyrites	9	8	101	0
Sandy clay	49	9	150	9
Plastic clay	30	3	181	0
Sands with clay	4	0	185	0
Lignitiferous clay	4	0	189	0
Sandy clay	4	0	193	0
Sand with lignite	13	0	206	0
Sandy clay	10	0	216	0
Sand with lignite	59	6	275	6
Dark clay (impure lignite)	3	0	278	6
Sand with lignite and brown coal	56	6	335	0

At 197 feet a flow of water, 8,400 gallons a day, was struck; the water rose to within 20 feet of the surface. At 226 feet this volume increased to 252,000 gallons a day, the water rising to within 10 feet of the surface. At 262 feet, 240,000 gallons a day were found. On boring deeper, this flow ceased, and the water was lost; but about a fortnight after, on boring still deeper, a flow of 350,000 gallons a day was struck at 295

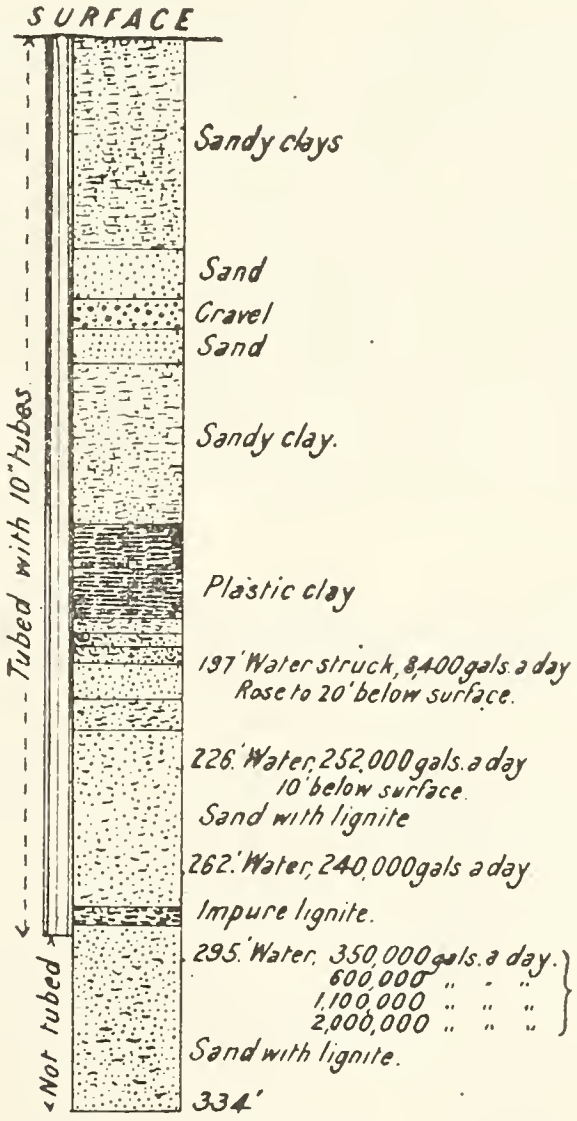


FIG. 23.

feet. As the bore was made deeper this flow increased to 600,000 gallons, then to 1,100,000 gallons, and finally to about 2,000,000 gallons a day. (These estimates were made by Mr. Bowman.)

This water was at first of very dark colour, owing to the amount of lignitic material in the sand, and the occurrence of a thin bed (3 feet) of impure brown coal. After running for some time, the water became much clearer, and it is now of a grey colour, highly charged with fine to medium grained quartz sand. This sand shows evidence of considerable attrition, a large proportion of the grains being rounded, the others partially so.

With this sand small lumps of nodular pyrites are being washed up. Some of them have pieces of lignite and brown coal attached; others are practically pure pyrites with rounded surfaces, showing, as a rule, evidence of attrition. The pyrites has probably been formed by the reducing action of lignite or carbonaceous matter on sulphate of iron in solution. Besides the sand and pyrites, lumps of lignite are washed up. One large lump forced up was within the fraction of an inch of the diameter of the bore tubes in size. It was about 14 inches long, and weighed 15¼ lbs. in its wet state. It caused a diminution in the flow for several hours during its gradual passage up the pipes. On its ejection, the flow again became equal to the estimated 2,000,000 gallons a day. As the sand comes out of the bore, it is shovelled out of the launder and channel leading away from it. This work requires the constant services of two to three men. Calculating from the rough measurements I took, there are upwards of 600 cubic yards of sand lying around the bore site. In addition, a large amount has been carted away. As most of this sand has probably come from beneath the beds of clay at depths from 140 to 216 feet, it means that a considerable cavity has been worked out round the bottom of the bore. The more sand that is brought up, the greater this will become, and the weight of a long column of 10-in. tubes, with no lateral support, is a serious matter. While the clays remain intact, these rods will have a certain amount of their weight relieved, owing to the swelling of the clay. It is this swelling which has wholly or partially caused the large tubes to become fast, thus preventing the column from being forced down lower than 277 feet. But should this clay give way, owing to the collapse of the immediately underlying sands, and the water pressure continue as great as at present, there is a probability of the overlying sand also collapsing around the bore-hole into the cavity and being washed out. Thus the creep may continue until the surface sags, and damages the town baths, and possibly the water tower. The matter, therefore, has possibly a serious aspect.*

I understand that the object of the bore is to get sufficient water to fill, for ornamental purposes, a local depression called Lake Gutheridge, and that the water is not required for domestic use. Quality, therefore, is not of great importance. The water is charged with sulphuretted hydrogen which gives it an unpleasant odour, but this will disappear on exposure to air. The supply now obtained will, in a short time, fill the lake, should the present rate of discharge be maintained. The Borough Council of Sale hopes, by deeper boring, to reach a bed of gravel with purer water and less discharge of solid matter. It is difficult to offer any suggestion on this point. There is no complete record of the strata passed through in a bore sunk close by for the council by a private firm in 1884. It is said that this bore was 301 feet deep, and that the water just flowed over the surface. In an endeavour to go deeper, the whole of the supply was lost, from what cause I have not been able to ascertain. I obtained the

* Early in May, 1906, the ground around the mouth of this bore did actually fall in, leaving a hole 12 feet in diameter and 30 feet deep. This has been filled up by the council. As the discharge of sand and water from the bore almost entirely ceased shortly after my visit, on the bore being sunk deeper, there is no likelihood of any further subsidence here.—A. E. K., 5.10.06.

following records, which show the strata to a depth of 174 feet only; nothing below that depth seems to have been tabulated:—

Beds passed through by the bore put down in 1884.

Strata.	Thickness.	Depth to bottom of bed.
	feet.	feet.
Clay	24	24
Gravel	4	28
Greyish clay	33	61
Gravel and sand drift	49	110
Reddish clay	12	122
Tough blue clay	18	140
Fine sand drift	2	142
Tough blue clay	14	156
Sand drift	4	160
Tough black clay	14	174

This, as far as it goes, corresponds fairly well with the records of the present bore, and it is rather unfortunate that the nature of the underlying strata was not recorded.

Two aspects of the case have specially to be considered:—

1. The possible purer water supply at a deeper level.
2. The preservation of the present bore-hole.

Regarding the former, experience in various parts of Australia shows that in strata such as these at Sale, which consist of alternations of pervious and impervious beds in an artesian basin drawing its supplies of water from a large area, it is not unusual for a flow of water obtained in one stratum to be lost by boring through the underlying stratum in the hope that a stronger flow or better water may be found below.

This would happen if the lower pervious bed were not highly charged with water, for, as soon as the intervening impervious bed were pierced, water from the overlying pervious bed would flow down and be lost. Sale lies in a large artesian basin, comprising wide plains and undulating country, stretching from near Warragul on the west, past Bairnsdale on the east. It receives the drainage of the La Trobe, Tanjil, Tyers, Thomson, Macalister, Avon, and Mitchell Rivers from the north, and the Moe, Morwell, Traralgon, Flynn and smaller streams from the south. It must contain vast stores of underground water, since the strata are largely of a pervious character.

With the possibility in view of losing the present supply, it seems to me advisable to be content with the water that has been obtained, since it appears suitable for the desired purpose. Should it be decided to try deeper, boring should be carried on very carefully, and the material brought up carefully examined.

Now, as to the second aspect, which is a mechanical one. The nature of the water is such that iron pipes are undesirable. The water being slightly charged with hydrogen sulphide will corrode the pipes, and in time render them useless. The council has decided to place a column of wooden pipes inside the iron tubing, and wishes to have them of as large a diameter as practicable. The foreman in charge of the drill (Mr. E. Keighley) tells me that it is impossible to force the 10-in. tubes down further than they now are (277 feet). Since the bore is 334 feet deep, there is a column of 57 feet to be tubed. For this, 8-in. tubes are necessary, and should, I think, be put down at once. This would, of course, necessitate a reduction in the diameter of the wooden tubes (which will have to go inside the 8-in. ones) to about 6 inches, assuming the wood to be $\frac{3}{4}$ inch thick. The flow would probably be reduced, for though a certain

small amount of water reaches the surface along the outside of the tubes, it differs in colour from the main flow, and carries clay instead of sand in suspension. Unlike the large flow, it probably comes from the strata above the thick clay bed. Should the 8-in. tubes be put in at once, and the water allowed to run for some time, it could be seen if there is likely to be any decrease in the amount of sand discharged, and if the water is likely to become clear.

Dutson Spring.

At Dutson, about 8 miles S.E. of Sale, there is a large supply of good clear water, which emanates apparently from springs, in a ti-tree morass. The result of an analysis of this water, made at the Agricultural Department Laboratory on the 29th January, 1905, is appended. It is locally suggested that the water there is of artesian origin, and that if the present bore be sunk deeper this supply might be tapped.

I made a hasty examination of the locality, and found that the water occurs in a shallow gully, a few chains wide, lying in a series of Cainozoic sediments, comprising fossiliferous earthy limestones of marine origin (older Cainozoic age), overlain by sandy clays.

Mr. Robinson tells me that he has noticed there is little or no variation in the volume of discharge of small streams running from it at any time of the year, and, in his opinion, the water is not of direct surface origin. The place is completely under water, and covered with a dense growth of ti-tree, sword grass, ferns, &c., so that nothing can be seen. I have no doubt that it is fed by springs, but as to their artesian origin I cannot express an opinion without carefully examining the locality. I am indebted to the local gentlemen, who showed me the Dutson springs, and furnished information.

[*Report sent in 27th July, 1905.*]

The following account of the old and new wells at Sale is republished from the *Gippsland Mercury* of 28th July, 1905:—

"The first artesian well in Sale, and, indeed, in Australia, was sunk by the Borough Council in 1880, a quarter of a century ago, and its success attracted visitors from all parts. It was situated at the Presbyterian Church corner, in Macalister-street, and had a depth of 231 feet. In that year an analysis was made of the water by Mr. Johnstone, then Government Analyst:—

	per gallon.
Sodium Chloride Sodium Sulphate Magnesium Chloride Calcium Chloride	17.6 grains.
Clayey matter	3.2 grains.
Total solids	20.8 grains.

The well, after running freely for some years, ultimately closed, owing to the corrosion of the pipes. Prior to that, however, a second well of larger dimensions was sunk in 1883 by Messrs. English, Palmer, and Luke, the well becoming the sole property of Mr. Henry Luke. At the outset this well achieved great popularity, Mr. Luke erecting baths, which were extensively patronized winter and summer alike, the water maintaining an even temperature of 66 degrees. Water was supplied to the Railway Department, and proved excellent for steaming purposes.

In 1883 the following analysis was made of the water from Luke's well:—

	per gal.
Sodium Chloride	6.6 grains
Calcium Chloride	2.4 ,,
Magnesium Chloride	2.4 ,,
Sodium Sulphate	1.6 ,,
Clayey Matter	1.4 ,,
Total	14.4 ,,

From this well a flow of 120,000 gallons per day was recorded from a 5-in. pipe. Its depth was 284 feet, and the flow had a head of 43 feet. This well ceased to flow, owing, it was supposed, to subsidence at the bottom. Next, the council essayed a well on the Market Square, which was not successful, and it was then decided to put down another bore on the old site in Macalister-street, which in 1885 was successfully performed by Mr. S. Lacey. This well was close by the old bore, and water was struck at about the same depth.

This was an excellent water in every way, although the common salt was high, and accountable no doubt for the quick corrosion of the pipes, which closed its career.

The New Well.

As our readers are aware, the new bore at the Market-square has been successful in striking a large body of water with 10-in. pipes, which is always over a million gallons per diem, and close to a couple of millions at times. The pressure may be gauged when we state that a piece of lignite, which was a tight fit for the 10-in. pipe, came up, and when scaled weighed $15\frac{1}{4}$ lbs.

The motive for making this fresh search for artesian water was to fill a swamp, which the drainage of the town ran into, and which in dry seasons was a menace to the health of the public as reported by all the medical men. The mighty flow of water is rapidly achieving this object. The bore is a 10-in. one, and the pipes have been successfully sunk to a distance of 277 feet. The boring rods, when put down below the pipes to a depth of 320 feet struck the present flow of water, which has been running uninterruptedly since Noon of Thursday, the 20th July. The water exhales a very strong smell of sulphuretted hydrogen, but it is of little import to the men working. The temperature varies from that of the one above alluded to, being $64\frac{1}{2}$ degrees. The work has been carried out by a Government plant, at the expense of the municipality, by Mr. Keighley, who, with his men, deserve every credit."

ARTESIAN BORES AT SALE.

(NO. 9 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Mr. Kitson has very fully reported upon these bores (27.7.05); but, in response to urgent telegrams, I visited Sale on the 14th inst.

Two bores have recently been drilled at Sale. No. 1 bore-hole is on the Market-square, and in the correct position to meet the requirements, which are—First, to have a constant stream of fresh water flowing through

the newly-erected baths; and, second, to run the overflow into a shallow lake, covering an area of about 90 acres. The surface at this site is 27½ feet above sea-level, and when Mr. Kitson examined it the depth of the bore was 334 feet, and the flow about 2,000,000 gallons per diem. The water at first brought up a certain amount of sand and silt, but later became quite clear. As the flow of water was more than enough to meet all demands, Mr. Kitson advised that the supply should not be interfered with. Other counsels prevailed, and a 5-in. bore was continued to a depth of 520 feet. At about 400 feet the supply of water was lost, and subsequently 50 feet of 10-in. tubing was broken off, and remains in the ground; the bottom end is 277 feet from the surface. At this depth a flow of water equal to 1,800,000 gallons per twenty-four hours was met with just below a bed of compact lignite. This water was clear and constant in flow. The 10-in. tubes are down to 167 feet; then there is a gap of 60 feet to the length of 10-in. tubing broken off. It is proved that over this area artesian water in abundance is procurable, and at this site a sufficient supply can be secured at about 277 feet from the surface. There are two ways by which the water might be obtained. First, an 8-in. tube might be inserted in the 10-in. tube, and worked down to a depth of 277 feet, where the former supply was obtained. Then by washing the sand out and stirring it up, the flow might be recovered. This would be the less expensive plan, and, if successful, operations in the way of boring could stop.

If this plan failed a fresh bore-hole might be drilled a little further away from the baths and the water-tower to about the same depth (277 feet), and the supply formerly cut would probably be found.

No. 2 Bore.—The surface here is 30 feet above sea-level, and the site is at the corner of Raymond and Macalister streets. The position is not suitable, for if a supply were obtained it would have to be conveyed in pipes for a considerable distance to No. 1 site on Market-square; and, moreover, as the supply of artesian water is distributed over the whole area, a bore may just as well be put down where the water is required as at a distance from that point. The depth of this bore is 238 feet, 50 feet being through sand and lignite. The 10-in. tubes extend to a depth of 107 feet. Inside the 10-in. tubes 8-in. tubes are inserted, and they extend to a depth of 238 feet. The end of the 8-in. tubes has been contracted so that the orifice is only 3 inches across. The present flow of water—which is at times clear, at other times charged with sand and silt—varies from 150,000 gallons per twenty-four hours down to a mere trickle, when the lower end of the pipe is choked with lignite. The contraction at the orifice of the 8-in. pipe greatly impedes the flow of water, and facilitates stoppage by the fragments of lignite.

The site of a bore put down in 1884 is close by, and this small bore-hole was apparently re-started by the drilling operations at the No. 2 bore, and caused some alarm when the water from it spouted up around the edges of the pavement by which it is now covered.

Since this hole has been drilled it might be kept flowing for a while, and the water will help fill the lake, but further operations at this site are not desirable.

The sand brought up indicates river origin—it is certainly not sea-sand. The borings at Sale go to show that over the whole of the Cainozoic area lying between the hills and the coast line artesian water is obtainable at moderate depths.

At Dutson is a copious supply of excellent fresh water at an elevation of over 100 feet above Sale. The spring is about 8 miles S.E. from Sale, and it very probably is of artesian origin, rising as it does in

Tertiary rocks. Close by are valuable compact limestone deposits of early Tertiary age, perhaps Eocene. Mr. Robinson has an extensive quarry in these beds, and very perfect shell casts are obtained there.

I have to express my indebtedness to the mayor, Mr. Lyon, and to the engineer, Mr. Bowman, for much courtesy and information.

[*Report sent in 21st November, 1905.*]

CERTAIN GOLD REEFS AT RUTHERGLEN.

(NO. 10 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

This gold-field is 169¼ miles N.E. from Melbourne, and 4¾ miles from the Murray River. A very noticeable feature is the remarkable manner in which deep alluvial leads radiate to all points of the compass from the town, which stands on an island of Ordovician rocks in a Tertiary area. No fewer than seventeen different leads have their origin within a small area, and these have been worked into deeper ground with varying success. Some of them yielded very rich returns, while others gave only moderate results.

It is natural to assume that a tract of country which has supplied so much gold to these alluvial leads should contain auriferous quartz veins in the bed-rock, and this has been proved to a certain extent; but quartz mining here has never assumed an important position, although from time to time excellent returns have been obtained. The reason appears to be the general absence of those strongly marked quartz lodes that are characteristic of some other gold-fields.

Ordovician sandstones, slates, and mudstones occupy this area, and although no fossils have been discovered, the character of the rocks suggests that these beds may belong to the Castlemaine zone. Along certain lines the beds consist of soft sandstones, mudstones, and slates of yellow and pink colours. The soil formed from these beds is of deep red colour. Higher up in the series, and flanking the above rocks, are beds of coarse sandstone and slate of grey colour, the soil from which is of light yellow or grey colour, and less fertile than that from the deeper-seated beds. The strata are bent into a series of anticlines and synclines, but the surface is so much covered by soil that there is difficulty in tracing out the centre-country.

The hills to the west of Rutherglen are thickly strewn with fragmental quartz. At Quarry Hill the beds strike N. 20 deg. W., dip 60 deg. W., and pitch N. at 10 deg. On this hill the rocks are rough sandstones with some beds of slate, both grey in colour, and the soil is also grey. Eastward from this hill is a little rise on which some mining has been done. The rocks here consist of soft pink and yellow sandstones, mudstones, and slate, with red soil. The latter beds are deeper in the series than the beds on Quarry Hill.

South-west of Quarry Hill, and just south of the Bobby Burns lead, there is a cutting on the main road to Springhurst. The beds here strike N. 20 deg. W., dip 64 deg. W., and pitch N. at 8 deg. An anticline probably runs close by to the east of the cutting.

Within the fence of Meehan's grazing area Ruhe Brothers are working surface spurs near the western boundary. These spurs cut through slate and sandstone; they have only been worked to shallow depths. A few loads of quartz, estimated to yield ½ oz. of gold per ton, are ready for

carting to the battery. The spurs range from 1 to 6 inches in thickness, but are not continuous for any great length.

Walker Brothers (3) are working within the same grazing area, but further to the east, on "Our Bob's reef." This consists of two walls, from 1 to 4 feet apart, on each wall of which there occurs a quartz vein, that ranges from 1 to 6 inches in thickness; the remainder of the space is filled with country-rock. The strike of this reef is N. 20 deg. W., and the dip is W. at 80 deg. The country rocks, consisting of slate and micaceous sandstone, dip W. at 60 deg., and pitch S. at 5 deg. The walls of the reef are fairly well marked in parts. The reef has been faulted further to the south, and also northward; the throw is to the E. A shaft has been sunk to a depth of 85 feet by Ruhe Brothers. The northern end of this reef is being worked by J. Ives, and some shafts have been sunk to a depth of 60 feet. To the north, the reef has been worked inside of Prentice's vineyard, and to the south up to another vineyard, inside which auriferous specimens have been found. There can be little doubt that the alienation of the auriferous country around Rutherglen has most prejudiciously affected mining interests. The ground worked by Ruhe Brothers gives a fair return, and now and then rich patches are found. I was informed that fifteen months ago they washed 60 ozs. of gold from a dishful of veinstone from their claim. The gold is worth £4 2s. per oz. Arsenical pyrites occurs in the quartz.

Further E., and a little to the S., within a few chains of the middle road to Springhurst, in the grazing area near the magazine, there are two small lines of workings along a reef of irregular character. They are 1½ chains apart. The eastern line is being worked by Messrs. Wilson and Smith. The slate and sandstone are of favorable appearance, and the soil is red. A shaft has been sunk here to a depth of 24 feet. The reef dips slightly to the E., and the country rocks dip W. Quartz spurs up to 2 feet in thickness are being worked along this line, and there does not appear to be any regular channel. With the auriferous quartz copper pyrites occurs.

One and a half chains further to the east, a run of quartz has been worked for a length of 400 feet, and to a depth of 60 feet in the deepest part. Quartz spurs were the feature here. Most of the adjacent land is undoubtedly auriferous, and seamed with quartz veins; but it is private property, and not open to mining.

Northward from Rutherglen the Lancashire reef is situated at the head of the Lancashire lead. The country rock is yellow and pink sandstone, mudstones, and slate. Through this quartz spurs occur for a width of about a chain, and these have evidently been profitable to work, judging by the manner in which the ground has been turned over. These spurs mostly ranged up to a few inches thick. The workings stop abruptly on the northern side at a garden fence, but it is most likely that the auriferous stone is not bounded by it. A shaft has been sunk to a depth of 150 feet, and there are many others of less depth.

Old Garibaldi Reef.

The old Garibaldi reef, now known as the Rutherglen Quartz Company, is ¾ mile to the north of Rutherglen. It dips to the east. A new winding plant has just been erected, and the shaft has been sunk to 390 feet, but the workings were not accessible. The country-rocks are soft sandstones and mudstone of yellow and pink colour, soil red.

The Pipe-Clay Reefs.

The Pipe-Clay reefs are four in number; they are a little to the W. (4 chains) of the Garibaldi reef. These small reefs dip W., and cut

across the country-rock, which also dips W. The country consists of red and yellow soft sandstones and mudstones. The thickness of these small parallel reefs is stated to be from 6 inches to 1 foot, and the quartz to yield 2½ ozs. of gold per ton. Two of the shafts are nearly 100 feet deep; the others are much less. Messrs. Cooper (father and sons) have been continuously working here for the past twenty-five years, and state that £6,000 worth of gold has been obtained from the shallow ground so far worked.

The Great Eastern Reef.

The Great Eastern reef is about 2½ miles to the north of Rutherglen. The rich claims formerly worked by Messrs. Harris and Hollow were on this line, and they are said to have obtained £63,000 worth of gold from their workings, which only extended to shallow depths. Within the last few years the line of reefs (for there are two parallel reefs about 80 feet apart) has been traced southward for several chains beyond where formerly worked. The western reef is considered to be the richer.

North of the old workings, the reef has been traced for many chains, and into the private property of Mr. Carl Butcher. Dr. Harris, of Rutherglen, has erected a plant on this property, and sunk a shaft, and obtained crushings from the reef, which here ranges from 6 inches to 4 feet in thickness, and yields from 8 dwts. to 18 dwts. of gold per ton. The strike of the reef is N. 30 deg. W., and the dip W. 76 deg. This appears to be one of the best-defined reefs in the vicinity, and it should be still further tested in depth, and along its course.

[*Report sent in 1st May, 1906.*]

TIN ORE ON WILSON'S PROMONTORY.

(NO. 11 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Mr. T. E. Williamson, Inspector of Mines, has left a sample of tin ore (cassiterite), which is stated to be from Wilson's Promontory. This tin oxide is black in colour for the most part, but transparent red particles also occur (ruby tin). In size the grains range from half-an-inch long to fine sand. The sample is well water-worn, and it was probably obtained at some distance from its original source. It is of high quality, and a very valuable mineral, owing to the high price of tin, which has reached the extraordinary value of £162 per ton.

It is noticeable that the granite of the Strathbogie Range, where tin ore has been reported to occur; the granite tract around Marysville, in which tin ore has been, and is still being worked in alluvial ground; the tract of granite in which the southern branches of the Yarra rise, and in which alluvial tin ore was worked at Beenak, and the granite of the Promontory, where tin ore also has been reported as occurring at different points, are all probably connected beneath the stratified rocks with one another, and with the granite of Flinders Island and the rich tin-bearing granites of the northern and eastern portions of Tasmania.

In view of the abnormally enhanced value of tin ore, the granite areas specified are well worth the attention of prospectors, the more so because a proportion of tin ore in the wash that a few years ago would have been worthless, is now highly remunerative. As to whether such high values

for tin are likely to continue, it is difficult to prognosticate; but from the heavy decline in output in some of the chief sources of the world's supply of this metal, the probabilities appear to be in favour of the price continuing very high for some considerable time to come.

[*Report sent in 4th January, 1906.*]

TIN ORE AT GLEN WILLS.

(NO. 12 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

A belt of metamorphic rocks occurs at Glen Wills, extending to the east for a width of about 2 miles, and to the west for about ½ mile. This belt passes Sunnyside and extends northward for many miles along the granite boundary. The rocks appear to be part of the Silurian series which has been metamorphosed, and they are pierced in many places by pegmatite dykes of most irregular form. These dykes carry cassiterite, the discovery of which was the cause of the first opening up of Glen Wills. Considerable sums of money were expended, and costly plants erected to work some of the stanniferous dykes, but the results were unsatisfactory, and no attempt was made to further test the value of the dykes as producers of tin ore until quite recently.

An attempt to work one of the dykes is being made by a small party at a locality about 2 miles to the north of Sunnyside on the Tallangatta road. The workings are about 6 chains to the east of the road, on the bank of a small tributary of Wombat Creek. At the surface the dyke can be traced for a length of about 3 chains. This spot is about 700 feet higher than Glen Wills. The claim is being worked by means of a tail race, and an excavation about 70 feet by 20 to 40 feet wide, and 15 feet deep. At the time of my visit the cleaning up had not taken place. Cassiterite appears to be disseminated throughout the pegmatite rock in greater or less quantities, but whether it is sufficiently abundant to be remunerative, even by sluicing off the decomposed portion, remains to be proved.

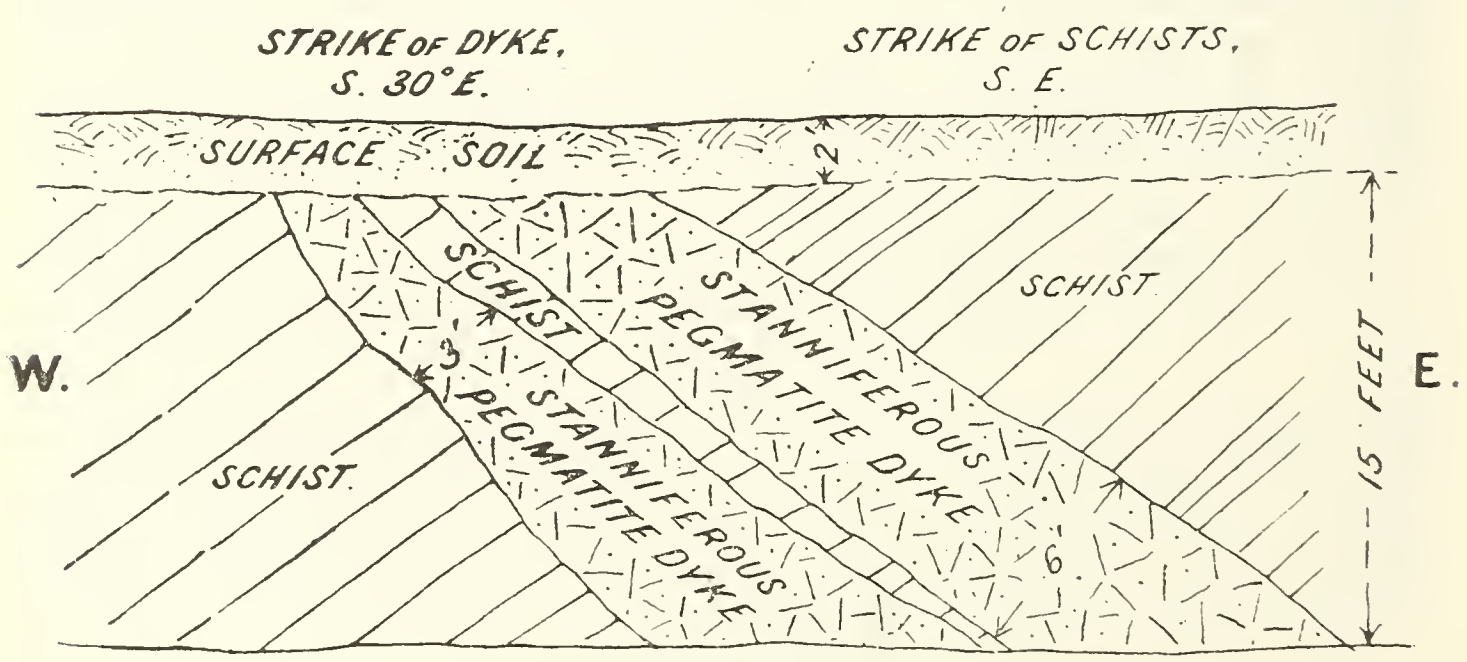


FIG. 24.

SECTION EXPOSED IN TETU AND PARTY'S CLAIM, 2 MILES NORTH OF SUNNYSIDE. SCALE, 10 FT. TO 1 IN.

About ¾ mile northward of Glen Wills, on the western bank of Sassafras Creek, 500 feet above the township, is a pegmatite dyke, known as the Soft Lode. It is in schist country, and about 2 ft. 6 in. thick. It is very flat (about 12 deg. from the horizontal), and it strikes about N. 20 deg. W. This lode was opened up many years ago by means of an adit along the dyke, also by an adit at a lower level further northward. There is cassiterite scattered throughout this dyke, and in some places it is in coarse grains and small veins. An attempt is being made to take the soft portion of the lode down the hill in a sled to Glen Wills so as to wash out the tin ore; but this is a very expensive way of working, and it is doubtful if even with the present high price of tin it can be made a success.

At the Blue Jacket mine, near Glen Wills, very considerable masses of tin ore were formerly obtained at the surface, but, although much work was done, further deposits could not be discovered.

This class of country (mica-schists, with stanniferous pegmatite dykes) appears to run for a considerable distance in a northerly direction for, on the Dorchap Range, similar dykes with disseminated cassiterite occur, but they have not been worked. Dorchap is about 9 miles N.W. from Mitta Mitta township, and the samples of pegmatite from that locality were shown to me by Mr. J. Caldwell at the township. Some of these appeared to carry an appreciable amount of tin oxide. The matrix in some cases is greisen. The belt of country in which the tin ore occurs is said to be about 2 miles wide. This tract should be thoroughly prospected now that tin is so high in price.

[*Report sent in 28th March, 1906.*]

GOLD AND TIN WORKINGS AT TIN CREEK, NEAR BUXTON.

(NO. 13 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Buxton is between Healesville and Alexandra, and is about 1,050 feet above sea-level. Tin Creek camp lies about 1½ miles W. 20 deg. N. from Buxton, on the western side of the Acheron River. Alluvial working for both gold and tin ore has been carried on for over half-a-mile along the course of the creek. Tin Creek joins Bishop's Creek, which flows into the Acheron River. The depth of alluvial ground ranges from about 5 feet at the lower end of the workings to bare rock a few hundred yards above the camp. The country-rocks forming the bottom along the creek course are Silurian sandstones and mudstones, which, near the huts, have a strike of N. 32½ deg. W., and a dip of 40 deg. westward. Six chains above the huts the strike is N.W., and the dip is westerly. The drift found in the alluvial workings consists largely of sandstone fragments, with much schorl derived from near the contact of the Silurian and granitic rocks higher up the creek. Stream tin in the form of only partially-rounded grains was obtained along this creek, and this also has been washed down either from the granite area at the head of Bishop's Creek, or from the fringe of altered Silurian in contact with it. Tin Creek was originally worked many years ago, and recent operations have been for the purpose of recovering what the original workers left behind. Mr. Ryall, who accompanied me over the ground, states that about 1 ton of tin ore has been obtained, and about 12 ozs. of gold.

On the northern side of Tin Creek, between it and Bishop's Creek, an older alluvial drift, composed largely of well-rounded pebbles of sandstone, occurs. This appears to be of Newer Pliocene age, and its floor is higher than the present creek bed. It is well developed about a quarter of a mile above the camp. Some holes have been sunk here to depths of from 6 to 20 feet, but no systematic tests appear to have been made to prove the value of the tin ore and gold per cubic yard.

A section disclosed in one of these holes (not bottomed) is as under:—

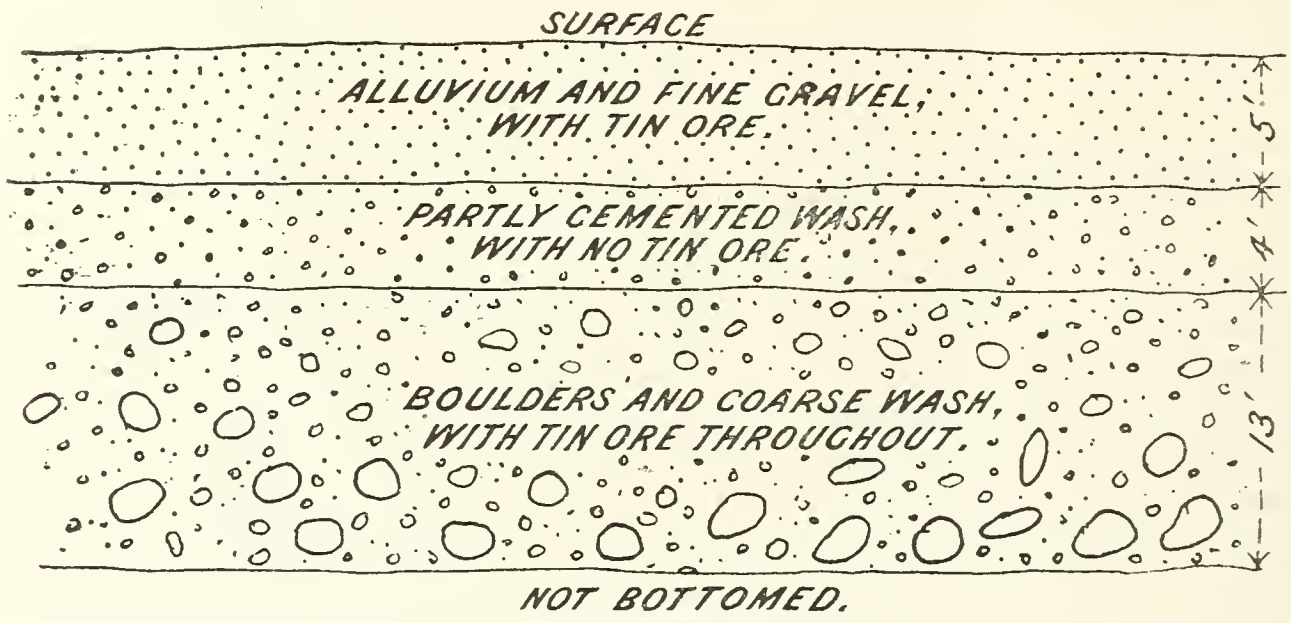


FIG. 25.

SECTION NEAR THE HEAD OF PIPE TRACK, TIN CREEK, NEAR BUXTON.

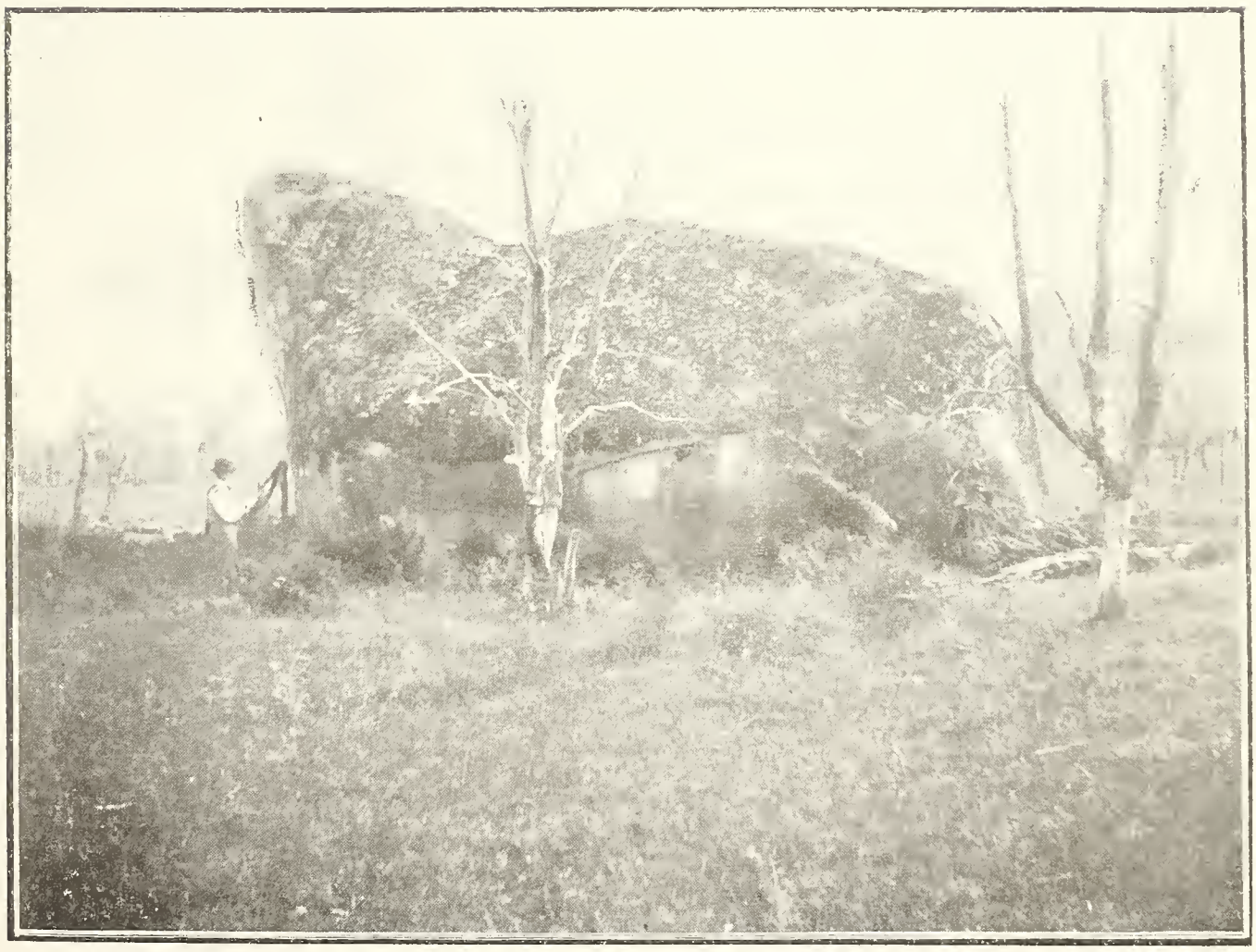
This older drift is extensive, and has no doubt been deposited by Bishop's Creek or its former representative. From Bishop's Creek the water supply is obtained for hydraulic treatment of the drifts of Tin Creek. The tin ore that occurs in the older drift has doubtless come down the valley, and, therefore, it should be more plentiful and in larger grains nearer the source. Prospecting should be done further up towards the granite boundary. Although a considerable amount of money has been spent on Tin Creek the value per cubic yard of the old gravels has not been demonstrated.

This could be done by taking out a paddock near the pipe track, and estimating the value of the tin ore and gold saved by washing away a measured block of ground. The price of tin is abnormally high at present, and the ore is, therefore, well worth searching for. There is an extensive outcrop of granite—some 30 miles long by 20 miles wide—to the east of Buxton. The granite area and the area of the contact with the Silurian rocks deserve prospecting. To the west of Buxton is a smaller area of granite, and this tract also should be tried. Mr. Passing, who is in charge at Tin Creek, conducted me over the workings.

About ½ mile N.E. from Buxton there is a large granite block resting, so far as can be seen, on alluvial ground. Probably it has rolled down from the high range to the east and come to rest in its present position. The side facing the north suggests that it was formerly the base of the mass, for it is not much weather-worn, while all the remainder of the surface is well rounded. Roughly this block is 42 feet long and 36 feet wide at its widest part, and about 22 feet high at the highest point. The weight cannot be far short of 1,000 tons. It is a remarkable object, and bears a rude resemblance to a sea elephant. It might be called Sea Elephant Rock. I am indebted to Mr. Ryall for the photograph here reproduced.

PL. XII.

GOLD FROM BUXTON.



THE SEA ELEPHANT ROCK, BUXTON.

BRITISH MUSEUM
NATURAL HISTORY

The Indicator Mine.

About $3\frac{1}{2}$ miles E. 10 deg. S. from Buxton, on the southern flank of the Cathedral Range, is the Indicator mine. Its height above sea-level is about 1,900 feet. The country-rocks are Silurian mudstones, sandstones, and shales, of grey, black, and brown colours, amongst which are some good examples of "paper-shales"—shales which split up into unusually thin leaves. The strike of these beds at the adit is N. 30 deg. W., and the dip at the mouth of the tunnel is W. at 70 deg. Near the puddling machine lower down the gully the dip is E., indicating the existence of an anticline to the east of and close to the present workings. Intersecting the Silurian beds is a dyke of dioritic character. It is from a few feet to 30 or 40 feet wide. The strike of this dyke is a little to W. of N. Iron pyrites occurs both in the dyke stone and in the Silurian beds, but the pyrites in the latter decomposes very readily. A thin ferruginous seam partly runs in the dyke itself, and for part of its course it follows along the western side of it. The same vein also cuts through the shales and mudstones. Where the vein is in contact with the dyke, or within the dyke, it bears gold in places.

The gold from this vein is of great purity, and of very remarkable character. Much of it consists of long, slender, splinter-like pieces, with crystalline characters. Some of the splinters are $\frac{3}{4}$-in. long, and not more than 1-10th inch wide at the broadest part. The ends of some terminate in beautiful small crystals, while the sides are in some cases fluted. A little quartz is attached to some of the splinters. (See plate.)

In the small gully, a short distance above the hut, a tunnel has been driven 70 feet into the hill on the western side of the gully. The direction of the adit is W. 30 deg. S. About 50 feet along the adit a branch, 15 feet long, has been driven in a northerly direction. In it the small ferruginous vein has been traced in the Silurian beds, but it runs out at a low angle to the horizon and terminates against the dyke.

At 70 feet along the main tunnel the small vein has been worked to below the floor of the adit, when the water prevented further sinking. The vein is $\frac{1}{2}$-in. thick, and the strike is about N. and S.; it goes down nearly vertically. The auriferous shoot pitches northerly. Higher up the slope of the hill, a shaft was sunk in the dyke for 110 feet, following the small vein down, but water prevented deeper sinking. At 60 feet further up the rise a shaft, 40 feet deep, was sunk in the dyke, which is over 30 feet wide at this point. Gold was obtained in the vein, but the principal shoot has gone underfoot below the tunnel level. To the N.W. of the present workings is a deeper gully which the dyke crosses. By driving an adit in on the dyke the mine could be unwatered for some depth below the level of the present adit; and besides, the whole of the ground could be prospected from the surface downwards to the level of the suggested tunnel. Where the dyke crosses the anticline it should be well tested. In the branch from the adit what looks like an anticlinal arch occurs, but it is rather indistinct. A little more driving here should prove whether it is centre country or not.

The dyke persists for a long distance, and the lower side should be systematically loamed, so as to locate any other shoots of gold along its course. This occurrence is well worth following up.

Between the above site and Buxton are alternate ridges of Silurian and granitic rocks. It is stated by Mr. Emil Stagel, who is at work with Mr. Johnson on the "Indicator," that gold can be obtained by washing

prospects in the creeks of this neighbourhood, and as very little prospecting has been done, further attention might well be bestowed on this tract, as both gold and tin ore occur in the locality.

[*Report sent in 11th December, 1905.*]

SOME GOLD MINES AT TANJIL.

(NO. 14 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

At Tanjil the country-rocks are of Silurian age. The beds consist of silicious sandstone of varying degrees of fineness, mudstone, and clayslate. The beds are bent into a series of anticlines and synclines, and dip east or west, the strike being a few degrees W. of N. Although this structure prevails and saddle-reefs probably occur, apparently no effort has been made to prospect the anticlines.

Dykes of diorite are numerous, and they appear to correspond in a general way with the strike of the Silurian beds, or, in other words, to follow the axial lines of fold in the stratified rocks. They are generally associated with quartz veins, which are found either in the mass of the dyke, or on one or on both walls. Such quartz veins have been proved auriferous in several instances; but the dykes have apparently been worked only to a limited extent, and none of them appear to have had a thorough trial.

Quartz veins and reefs are common in the Silurian beds, but they do not seem to have been worked very extensively. In fact, Tanjil in its early history was an alluvial diggings, where gold was obtained in fair abundance and with little effort, and up to the present time practically all the attention of the miners has been confined to alluvial mining, and the sources from which the alluvial gold was derived have not been vigorously sought for.

The Silurian rocks are covered by beds of silicious conglomerate, loose sandstone, gravel, clay, &c., and also by lava flows of older volcanic age—basalt of very dense character that covers the older Cainozoic leads. Examples of this occur in Morrison's paddock about a mile to the south of Tanjil, where basalt covers grey silicious rock and conglomerate. Cement lead and Moonlight lead, both in Morrison's paddock, belong to this Older Tertiary, and good yields of gold were obtained from the gravels and conglomerated gravels of this age. Moonlight lead was opened up by means of a Government grant of £500.

Newer Tertiary leads were worked close to Tanjil, and a little to the west of it. About a mile further up the river, a lead of the same age and probably the continuation of the Tanjil leads, was worked in Dawson's Gully with payable results. In the small gullies on the northern side of Tanjil, boulders of intensely hard grey silicious rock and conglomerate, that have been thoroughly rounded and even half polished, are found. They have, doubtless, been derived from a still older lead, and were again worn down in the Newer Tertiary river course, and then finally once more denuded and left with recent drift in the gullies where they now repose. The material is identical with that covered by basalt in Morrison's paddock. At Tanjil and nearly on a level with the river bed a lead is now being

worked by Mr. Atkins and his partner; it, also, appears to belong to the Newer Tertiary period; but there is quite 150 feet of difference between the level of this lead and the one to the west of Tanjil.

Drifts of recent age occur in the flats, on the banks of the Tanjil River and along the various gullies. When first worked they are reported to have yielded gold in abundance, but there is a great lack of precise data. The alluvial gold is reported to have consisted largely of extremely well water-worn pieces, and was in many cases of a coarse description.

Reefs, Etc.

Eureka Dykes.

One and a half miles to the north of Tanjil, on the western bank of the Tanjil River, there are two parallel dykes, 9 feet apart, named the Eureka dykes. They strike N.W., and dip 76 deg. to the S.W. These dykes are decomposed to a depth of 25 feet from the surface. Below that the material is hard and of bluish-grey colour. Quartz veins dipping W. occur in the dyke; they range up to 3 inches in thickness, and contain gold, but no authentic yields are known. From near the river bank tunnels have been driven along the dykes about 300 feet along the northern, and 150 feet along the southern, dyke. Several crushings are reported to have been taken from the tunnels, and there still remains the bed of a little crushing plant formerly employed on ore from the adits. Nearer the river is a shaft about 25 feet deep, and some rich returns are reported from some old workings close to this shaft. This lease is, it is understood, at present held by Mr. S. J. Pope and party. Across the river opposite the shaft is Barker's reef, a quartz vein cutting across the sandstone beds. Its strike is N. 12 deg. W., and its dip 56 deg. E. The quartz is about 8 inches thick, highly mineralized and hard, and quite unlike the quartz veins in the diorite dykes. So far no gold has been got in this reef.

On the Eureka dykes and about 4 chains N.W. from the adit-mouth a shaft has been sunk 80 feet. Quartz veins are said to have been worked here, but with what result was not known. Dykes of this class appear to be very persistent, and are traceable for long distances; generally they are veined with quartz. No very determined effort appears to have been made to test them in depth, although they present similar features to those of Wood's Point, from which phenomenally rich yields of gold have been obtained.

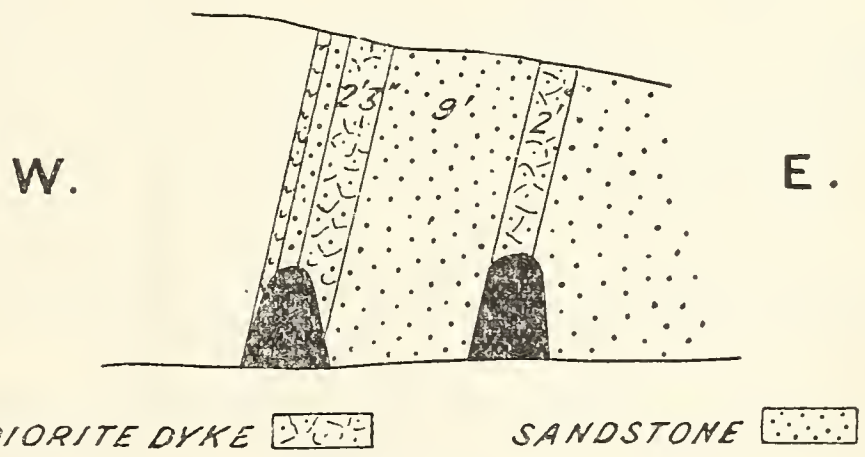


Fig. 26.

Westrop's Reef.

This reef is about 1½ miles N.N.W. from Tanjil. Its strike is N. 5 deg. W., and its dip 40 deg. W. The shaft is about 70 feet deep. The thickness of quartz is not known. Payable ore is said to have been worked here for two years.

Near the head of Dawson's Gully the Silurian sandstones strike N. 8 deg. W. and dip 70 deg. E.

Victory Reef.

This reef is about ¼ mile to the W. of Tanjil. The shaft is close to and on the northern side of the Moe road; it is 105 feet deep. A sollar has been put in at 85 feet, and the present workings are above this level. Most of the way the shaft follows the reef, which strikes N. 6 deg. W., and dips 65 deg. to 70 deg. W. The thickness of the quartz is from 2 inches to 12 inches, averaging about 6 inches. The pitch of the country-rocks is S. at 20 deg. Quartz from this mine is reported to have yielded up to 2 ozs. of gold per ton. Down to 70 feet Mr. Pope states the quartz yielded at the rate of 16 dwts. of gold per ton.

At present work is being done at this mine, and the reef looks sufficiently favorable to warrant further development. It could not, however, be examined in the bottom level. There is about 300 feet of ground between this shaft and the old shaft formerly worked on the same line of reef, but how much solid ground remains is not known. The old shaft is 60 feet deep, and from it a considerable quantity of quartz is reputed to have been won.

Klondyke Gully.

About 5 miles by road, in a direction a little W. of N. from Tanjil, is an alluvial working in a small gully, known as Klondyke. The country-rocks are Silurian sandstones and mudstones of grey and yellow colour. The strike of these beds is N. 12 deg. W. and they dip 67 deg. W. Covering the bed-rock to a depth of 8 to 10 feet there is alluvial material evidently derived immediately from the adjacent rocks. The coarser pieces of quartz, &c., are all angular, and the gold was very sharp, and not at all water-worn. Much of the gold had angular quartz attached to it. and there was no gold obtained that was at all water-worn. The gold appears to have been derived from the western side of the gully, and much of it was coarse, pieces up to 19 ozs. having been reported. Mr. Wright, who has been working this ground, pointed out the sites at which some of the heavier pieces of gold were found.

The gully has been worked for about 5 chains in length, and about 3 chains further on it joins Baker's Gully, which was very rich lower down its course. On the western side of Klondyke Gully the sandstone is veined with quartz, but no gold has been found in these veins. A fault in the beds occurs and is marked by a vein of ironstone (limonite). The fault pitches northward, and its dip is slight near the surface; but it soon bends over and dips more sharply to the E. Whether this vein of ironstone has anything to do with the occurrence of gold is not known; but a little prospecting along the course of the fault should be done.

A dyke runs about 2 chains west of the head of the gully, and outcrops near the top of the ridge, on the southern side of the track. Its strike is N. 20 deg. W. Some work should be done on the eastern side of this dyke near bed-rock, so as to discover if the gold obtained from the gully comes from the dyke, which runs nearly parallel with it.

About £1,200 worth of gold is said to have been obtained from the workings, which average 6 to 10 feet deep in the small gully, which is about 5 chains in length, and less than 1 chain wide. The gold found here, judging by the sample seen, must have been of local origin, and the quartz

attached is very suggestive of a dyke being the source from which it came. The drift of this gully is all of recent age, and devoid of rounded pebbles derived from Tertiary sources.

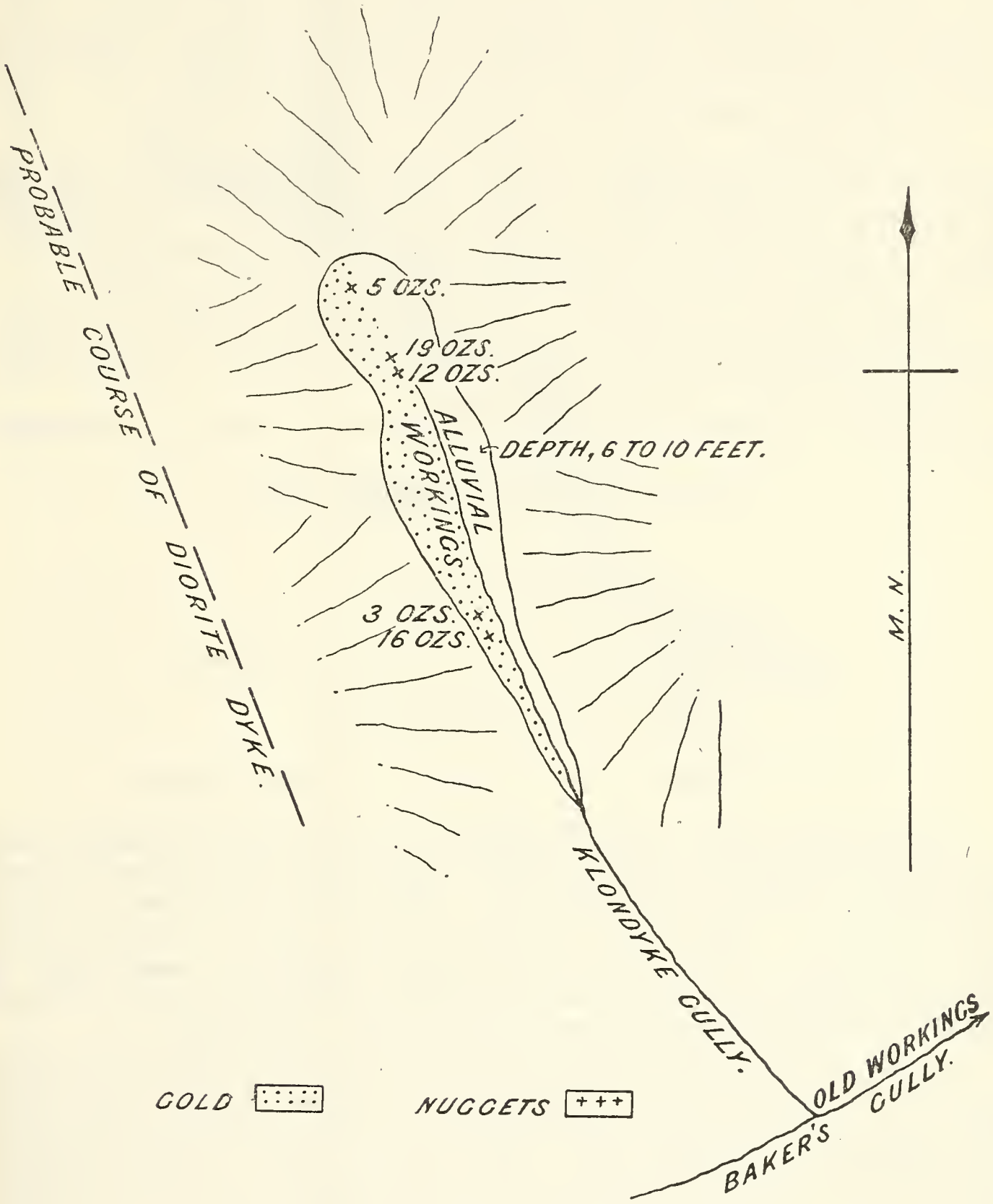


FIG. 27.

SKETCH PLAN OF THE KLONDYKE WORKINGS, HILL END, TANJIL.
SCALE, 2 CHAINS TO 1 INCH.

ROLFE'S FLAT.

Three-quarters of a mile to the south of Tanjil is Rolfe's Flat, around which the Tanjil River loops, leaving a narrow neck of Silurian sandstones not a chain across. The beds of sandstone at this point are almost horizontal. Through this neck a channel has been cut which diverts the bulk of the water in winter, while in summer the whole of the water takes the short cut, leaving the bed of the river around the loop dry. It is proposed to dredge the river drifts at this site.

Right opposite Rolfe's Flat on the opposite or southern side of the river and about 100 feet higher up the hillside the Cement lead is being worked by Morritt and Peterson. They skim off the bottom 3 inches of the cemented gravel and obtain a nice sample of gold of great purity worth £4 2s. per oz. Most of the work now being done on the alluvial ground consists of searching for and working odd patches that have escaped the earlier miners, and it speaks well for the field that even now, after more than forty years' work, the men so employed can earn a living.

It seems highly probable that there are tributaries to the Tertiary leads yet to be discovered; also, that where breaks occur in these old leads, there is still gold to be obtained by searching for it. In the alluvial ground along the Tanjil River course, and some of its larger tributaries, there is probably still new ground that could be profitably worked.

Between the spur from Baw Baw from which the Tanjil is fed and the ground already worked, is a belt some miles in width, in which alluvial and reef gold should be searched for.

Although a neglected gold-field, Tanjil is by no means an exhausted one.

[*Report sent in 25th November, 1905.*]

SOME GOLD REEFS AT ALEXANDRA.

(NO. 15 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

About ½ mile S.W. from Alexandra is the site of both alluvial and quartz mining for gold. The country-rocks are Silurian sandstones and mudstones of drab and grey colours. The strike of the beds is about W. 40 deg. N. The beds are bent over into a series of anticlinal and synclinal folds. These folds are frequently repeated in some cases at very short intervals, as in the cutting leading in a north-westerly direction towards Alexandra Road railway station from Alexandra.

Within the area recently taken up under leases there are two principal lines of reef—dipping to W.—about 500 feet apart, both of which conform with the strike of the containing beds, showing that they are "legs." The northern line is known as the Luckie line; the other as the Homeward Bound line. Between the two, at the north-western end of the workings, a third line, known as the Mysterious line, has been worked.

Crossing the two main lines of reef are two diorite dykes, each of them being a few feet wide, but they vary considerably in thickness along their course. The northerly dyke strikes about E. 20 deg. S., and its dip is nearly vertical. The other dyke strikes E. 10 deg. S., so that they converge in an easterly direction. They approach closely to one another at No. 2 shaft, on the Luckie line. The northern dyke is said to be traceable for many miles. It is noticeable that the old workings occur chiefly about the intersections of the dykes by the reefs, for the reefs have been formed subsequently to the dykes. In the present workings, it is these intersections that have to be followed up. The conditions under which the gold occurs are that diorite dykes striking a little S. of E. have intersected corrugated Silurian beds of sandstone and mudstone nearly vertically. The strike of the Silurian rocks is nearly N.W., and in the

case of the present locality the dip is 50 deg. to 75 deg. S.W., so that the intersections of the dykes with the "leg" reefs pitch to N.W. at a rapid rate.

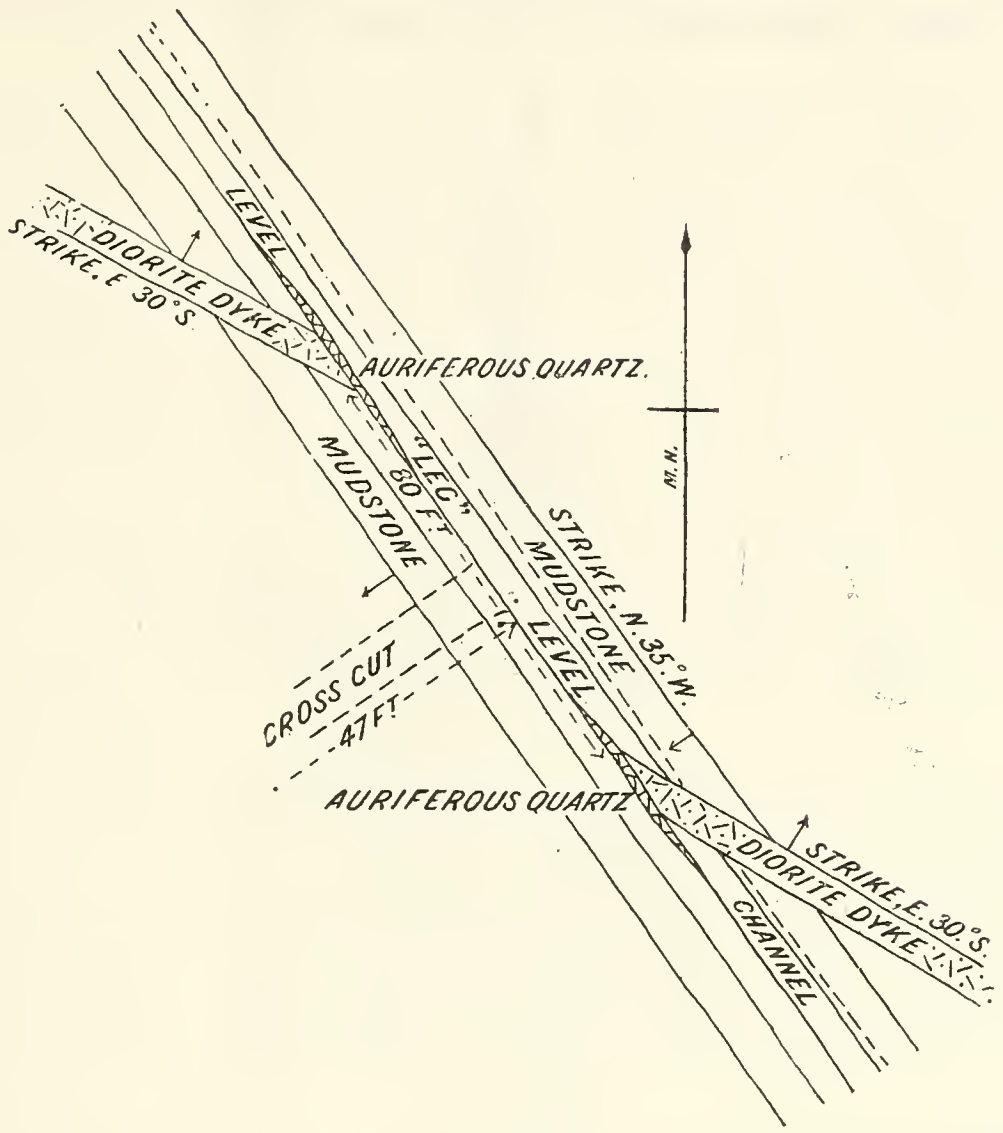


FIG. 28.

SKETCH PLAN OF THE HOMEWARD BOUND REEF, 300-FT. LEVEL; CROSS-CUT 47 FEET S.E. OF SHAFT.

The "legs" or reefs conforming in dip and strike with the Silurian beds have cut through the dykes which are faulted. In one case the dyke on the northern side of the reef is 80 feet away on the same level from the corresponding part on the southern side of the reef. At the contact of the reef with the dyke, the quartz expands. It is evident that the faulting movement, which has dissevered the dyke, has been along the bedding planes of the Silurian strata. As the dykes are persistent it would appear that along their course the country should be well prospected so as to test the intersections of quartz reefs wherever they occur. Centre-country must be to the north-east of the lines of reef being worked, and the intersections of the dykes and centre-country should also receive attention.

There are several old shafts on the lines of reef. The shaft now being used is on the Homeward Bound line; it is 450 feet deep. The dimensions are 7 ft. 6 in. by 3 ft. 6 in. to a depth of 300 feet; below that it is 10 ft. 6 in. by 3 ft. 6 in.

At the 300-ft. level the country-rocks dip S.W. at 75 deg. A cross-cut north-eastward has been driven 47 feet to the reef, which is 2 inches thick. Along the reef a level has been driven S. 35 deg. E. for 40 feet to the intersection of the dyke and the reef, and it terminates 50 feet in from the cross-cut. The strike of the "leg" of quartz is N. 35 W., and the dip is S.W. at 84 deg. The pitch of the country-rocks is north-westerly.

The reef was found to intersect the dyke at 40 feet from the cross-cut in a north-westerly direction, and at 40 feet in a south-easterly direction, giving a total displacement on this level of 80 feet. In this cross-cut, 15 feet from the shaft, is a fault dipping northward, and such faults have also to be reckoned with. The amount of displacement in this case is not known.

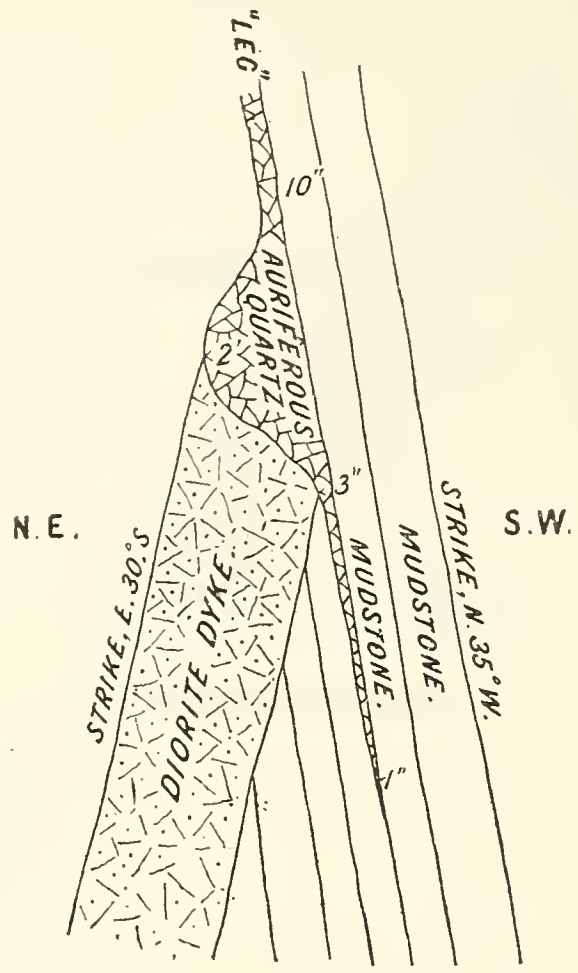


FIG. 29.

TRANSVERSE VERTICAL SECTION. LOOKING S.E. SCALE, 8 FEET TO 1 INCH.

At the 380-ft. level there is a cross-cut 30 feet long in a north-easterly direction to the reef channel, but no reef has been found. The level has been driven south-westerly for 58 feet. The dyke is in the end of this level. The pitch of the country-rocks is north-westerly at 42 deg.

The level to the north-west has been driven for 158 feet. At 27 feet a small quartz reef shows for a length of 12 feet along the level. At 47 feet an inch of quartz shows, and this increases to 8 inches in thickness at the intersection of the dyke and the reef. All the country-rocks dip S.W.

At the bottom (450 feet) level the cross-cut is 13 feet to the north-east where the reef channel was cut, dipping at 75 deg. S.W. The level has been driven to the north-west for 200 feet. At 180 feet the dyke was cut. The dip of the beds in the cross-cut is 75 deg. S.W.

From the Strathbogie Ranges on the north to the Gippsland railway on the south, and from the Macalister River on the east to the North-Eastern railway on the west, is a vast area of Silurian rocks intersected by dioritic dykes. In some localities, as at Wood's Point, Walhalla, &c., the quartz veins that occur along these dykes have been marvellously rich in gold. It is to be expected that where the same zones of Silurian beds are cut by these dykes, similar productiveness in gold will exist, and earnest attention is being directed towards identifying the fossils associated with such beds in order to be able to identify the different zones.

[*Report sent in 11th December, 1905.*]

THE UNION AND DORRITT MINE, GRANT, NORTHERN GIPPSLAND.

(NO. 16 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

This mine is about ½ mile northerly from Grant. The country-rocks consist principally of hard grey Silurian sandstones, with some slaty beds. The strike of the Dorritt reef is W. 20 deg. N., and it dips 65 deg. N.E. The reef, about 5 feet wide, occurs in a shallow shaft to the westward of the Dorritt adit. About 3 chains southward from the Dorritt reef is the Union reef, which is over 6 feet wide in places. These two reefs traverse the whole length of the leases held by this company. In a small hole, 2 chains west of the Dorritt tunnel, the reef is 4 feet thick. In the upper tunnel the sandstone is of purple colour. The reef is 1 to 4 feet thick. This tunnel has been driven 9 chains in from the north to where the stopes commence. They rise to the surface. Stopes have been taken out 70 feet below the level of the adit for a length of 300 feet along the Dorritt reef. Near the mouth of the adit (about 2 chains in) a dyke crosses the reef diagonally; it is in a decomposed state.

The Italian reef strikes off from the stoped portion of the reef in a direction W. 35 deg. S.; its dip is 80 deg. S.E. The reef is 6 to 12 inches thick, between well marked, smooth walls of hard grey sandstone. This reef was very profitable to work. The Italian reef runs towards the Dorritt reef on the northern side, but does not appear to have actually joined it. The shoot of gold in the Dorritt reef pitches E. 20 deg. S. at an angle of about 70 deg. The strike of the country-rock is about S.E.

The Union reef was also worked along a shoot for some distance, and further eastward was worked from the Union adit. The eastern end of this reef on the side of the hill has evidently broken away from its original course.

The Union tunnel is between 1,000 and 2,000 feet above Good Luck Creek. This creek was worked for alluvial gold. The strike of the reef in the Union adit is W. 20 deg. N. and the dip is 65 deg. northward, and the quartz is from 1 to 2 feet thick. The reef has not been worked below the adit floor. The length of the Union tunnel (cross-cut) to the reef is about 250 feet. Both the Union and Dorritt reefs have been worked for 170 feet in depth from the surface at the eastern end of the lease.

A low-level tunnel is now being driven to cut the reefs at a depth of 300 feet below the Dorritt adit, or 230 feet below the bottom of the stopes carried below the tunnel level. This low-level adit has been driven in 690 feet; there are still 250 feet to be driven before the Dorritt reef can be cut. The dip of the reef is away from the direction of the tunnel mouth.

This lower tunnel has crossed through the course of the Vulcan reef, which gave some good crushings, and which is about 200 feet to the south of the Rubbly reef, or 400 feet to the south of the Dorritt reef. A dyke occurs along the course of the Vulcan reef in the level along that reef from the adit. The Rubbly reef has also been worked at the surface for some distance, but it does not yet appear to have been cut in the adit. In the Vulcan reef the quartz is 6 to 12 inches thick. Its strike is W.

20 deg. N., and its dip 65 deg. northward. All the four reefs in this lease are parallel, and they all dip in the same direction. The cost of driving the lower adit is about 25s. per foot, and the rock now being cut through is a favorable-looking slate.

[*Report sent in 9th February, 1906.*]

THE GOOD HOPE REEF, GRANT.

(NO. 16 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

This reef is situate about 4 miles from Grant in a westerly direction. The strike of the reef is about N.W., the dip is nearly vertical, and the pitch of the shoots of gold is eastward. The reef is from 2 to 4 feet thick, but for considerable distances along the "channel" or course of the lode there is no quartz, beyond an inch or so, as proved in the deep level adit.

Formerly the reef was worked from adits. No. 1 adit is on the western side of a ridge, and has been driven S.E. along the course of the reef, which is here 1 ft. 2 in. thick. At 120 feet, the reef takes a turn southward. The strike of the reef is N. 20 deg. W., and the dip vertical. The height above sea-level is about 3,000 feet. Very little work has been done in this adit.

No. 2 adit was driven from the southern side of the spur, about 250 feet further to the east than No. 1, and lower down the hillside. It is 430 feet long, and a considerable amount of quartz was obtained from it.

No. 3 adit has also been driven from the southern side of the spur; it is about 100 feet further to the east, and considerably lower down the hillside than No. 2. It is 728 feet long, and from it the reef was extensively worked.

No. 4 adit is about 700 feet below the outcrop of the reef at No. 1 adit, and is 500 feet further to the east than No. 3. It is 1,112 feet long. The level at the end of the adit has been driven along the reef for 730 feet, and for a distance of 520 feet was in payable ore. Three winzes have been sunk below this level to a depth of 50 feet, and the reef was stoped. Underfoot the auriferous reef continues, and Mr. Noble, the manager, informed me that an average bulk sample along the whole length of the shoot gave a return of 17 dwts. 4 grs. of gold per ton of ore, as broken out. This is the lowest point at which work was done on the reef. The further exploration of the lode could be most quickly effected if an electric plant were erected to the north of No. 4 adit.

On the opposite side of the valley is the Uncle Tom reef, from which a small quantity of quartz was taken and crushed. Lower down the creek alluvial gold has been worked extensively. From the old workings, Mr. Noble informed me, 14,461 tons of quartz were crushed, yielding 23,357 ozs. of gold. The concentrates were rich, in some cases averaging up to 31 ozs. of gold per ton.

With the object of picking up the shoot of gold going underfoot at No. 4 adit, and also of exploring the "channel" of the reef for other shoots of gold, a low-level adit has been driven in from the western end of the reef. The mouth of this adit is about 600 feet below the level of No. 4, and 2,000 feet to the N.W. of No. 1. The adit is 6 ft. by 5 ft. in the clear, well timbered, and driven in hard country. The country-rock

PLATE XIII.

Plan of workings of

THE GOOD HOPE CONSOLIDATED GOLD MINE, GRANT.

Scale - 320 Feet to One Inch.

AREA - 105 · 1 · 21

THE UNION AND DORRITT GOLD MINE.—SECTION OF LOWER TUNNEL.

Scale: 2 chains to 1 inch.

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is Silurian sandstone, with a little slate. It is very much disturbed and crushed, so much so that there is difficulty in recognising the true bedding planes. Along the course of the adit, which it has taken several years to drive 2,800 feet, two shoots of auriferous quartz have been cut, one of them 200 feet in length, the other 600 feet. Near the end of the adit the country is much disturbed and bent southward, the result of a fault. As the course of the adit was deflected from the supposed position of the lode being driven for, a cross-cut was started 550 feet from its end, and driven in a north-easterly direction. At the time of my visit this cross-cut had passed through 172 feet of intensely hard sandstone, and there still remained 800 to 900 feet to be driven. At the mouth of the adit the plant consists of a 4½-h.p. Otto oil engine and dynamo, by which means an electric drill is worked, and the face lighted. By means of a fan and 12-in. piping, air is driven in to the face also. The height of the mouth of the adit above the Crooked River is about 650 feet. Between the Good Hope workings and Grant is the Magenta reef, which may be the eastward continuation of the Good Hope reef. This reef has been worked from several shafts.

Mr. A. E. Noble has kindly supplied the tracing, showing position of the several adits, &c.

[*Report sent in 4th April, 1906.*]

THE LONE HAND AND ROYAL FLUSH REEFS, GRANT.

(NO. 16 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

The Lone Hand Reef.

About ¾ mile eastward from Grant this reef crosses Mornington Gully. The strike of the reef is W. 30 deg. N., and its dip about 75 deg. S.W. The country-rocks are altered sandstones and slate of Silurian (?) age. Associated intimately with the reef is a diorite dyke. A fissure has apparently been filled with the molten igneous rock which contracted on cooling, and left spaces on one or both sides, between it and the enclosing sedimentary rocks. These spaces became gradually filled with quartz from solutions, the gold being deposited at the same time.

The dyke is 2 feet thick, and the quartz reef ranges from 5 inches to 2 feet. The walls have not been smoothed by friction, but are rough, as though they had been torn asunder, and the resulting fissure immediately filled with igneous matter. The quartz is well laminated, and gold shows freely in places. The gold is worth £4 1s. 6d. per oz. The Lone Hand reef has not been long opened up, but its westward continuation, known as the Jolly Sailor's reef, was formerly worked with success for a length of 200 feet. At the eastern end of the Jolly Sailor's reef there is a fault, which has thrown the eastern portion, or Lone Hand reef, 37 feet to the south. This reef is traceable for over 700 feet. It was in consequence of this fault that the Lone Hand portion of the reef was not previously worked. From the nature of the occurrence and its resemblance to the Union reef at Diamond Creek, it may be expected to be quite permanent to great depths. The conditions that are most favorable to the presence of auriferous reefs in Silurian rocks are the existence of dykes, and these prevail in the neighbourhood of Grant, hence the presence of auriferous reefs.

In Mornington Gully, near the reef, there is a 5-head stamp mill, with an 8-h.p. portable engine. The reef is being worked by a co-operative party.

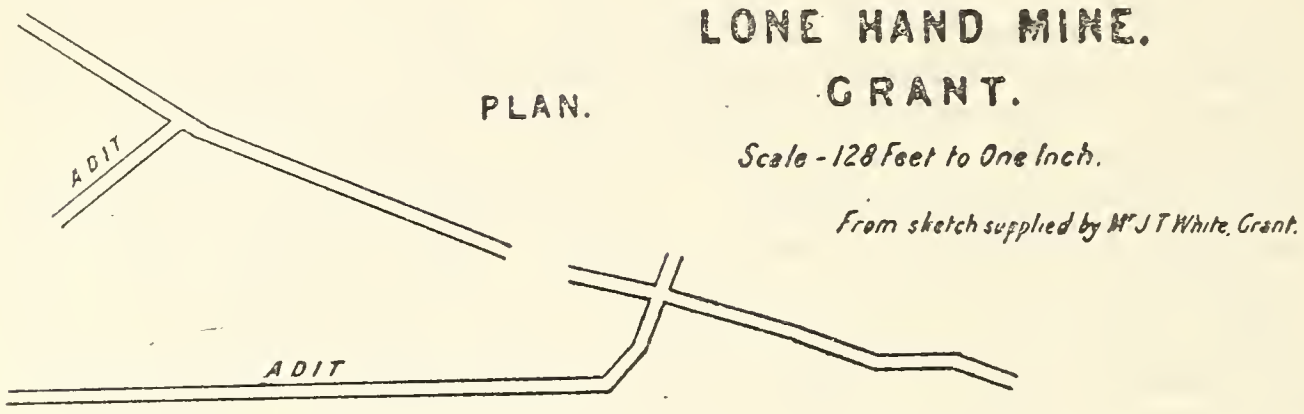

FIG. 30.

THE ROYAL FLUSH REEF.

Between the Lone Hand reef and Grant is a reef from 6 inches to over 2 feet thick, worked in conjunction with the Lone Hand, and known as the Royal Flush. The strike of the reef is W. 30 deg. N., and its dip south-westerly at 65 deg. This reef was worked by an adit for 400 feet in length, and it still continues westward, but is poor. The pitch of the shoot of gold is eastward. The country-rocks here and about Grant and for 3 miles back on the Dargo-road are soft decomposed micaceous sandstones and slates, frequently of pale pink colour; the soil is red.

A compass sketch of the workings at the Lone Hand mine was kindly furnished by Mr. White, of the co-operative party.

[*Report sent in 5th April, 1906.*]

SOME GOLD REEFS NEAR DARGO.

(NO. 17 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

The township of Dargo is situate in a granitic area, and several auriferous reefs have been opened up and are being worked within a short distance of the township. A Government battery is erected at Dargo for the purpose of encouraging the development of these reefs.

The Two C.'s Reef.

About ½ mile N.E. from Dargo this reef occurs. The country-rock is granite. The strike of the reef is N. 35 deg. E., and the dip is to S.E. at 65 deg. The reef is 1 ft. 9 in. between the walls, 1½ inches of quartz on the footwall, and 3 inches on the hanging wall. The reef has been opened up for ½ mile along its course, and two or three crushings have been taken out that averaged 1 oz. 9 dwts. of gold per ton. The gold is of poor quality, worth £2 19s. 6d. per oz. The reef is 250 feet above the level of the river. Coloe and Cummins hold a claim on the reef, hence the name. The quartz carries galena and pyrites, and will probably become highly mineralized at a moderate depth. This lode may be expected to be permanent in depth; it is conveniently situated for economical working.

About ¼ mile E. from Dargo, on a ridge, is a small quartz vein in granite. Its thickness is from 6 to 7 inches; its strike is E. 22 deg. N., and its dip southward at 60 deg. A shaft has been sunk 12 feet deep, and this has been extended along the reef. About 5½ tons of quartz were crushed from this surface stone for a yield of 17 dwts. of gold per ton. The proprietor is Mr. T. Sheehan.

Jorgenson's Reef.

To the east of Dargo township, 1½ miles, in J. Hurley's paddock, in granite country, is Jorgenson's reef, from 5 to 12 inches thick. It strikes W. 20 deg. S. and dips northward at 85 deg. Forty tons of quartz crushed from this reef gave 40 ozs. of gold. It is in the western slope of the range, and has been opened up for about 4 chains in length. A shaft has been sunk about 45 feet at 300 feet above the level of the river.

The Trail of the Serpent Reef.

At ¼ mile S.W. from Jorgenson's reef, inside J. W. Riggall's paddock, is another reef, known as the Trail of the Serpent. The country-rock is granite. The strike of the reef is E. 25 deg. N., and its dip southward at 85 deg. A shaft has been sunk on the eastern end near the boundary fence to a depth of 65 feet. From this crushings of quartz have been taken, but the yield is not known. Galena and calc-spar occur in this reef, and in places are 1 inch thick. There is, also, much iron pyrites. The reef has been traced for a length of 8 chains, and an adit has been driven for 60 feet from the western end. A dyke of dense dark blue diorite runs alongside the reef on the southern side.

These reefs in the granite are likely to be permanent, and many more will probably be discovered by searching for them.

Little Exhibition Reef.

Three miles from Dargo on the road to Waterford, inside a paddock, on the southern side of the road, the Little Exhibition reef, 2 inches thick, occurs. The country-rock is exceedingly hard, highly altered Silurian strata (hornfels). The strike of the reef is W. 20 deg. N., and it is vertical.

By means of adits this reef has been worked for ½ mile to the westward of the gully in which the lowest adit is situated, and right up the eastern slope to the top of the range and over on to the western slope. The reef ranged from 1 to 12 inches thick, and is said to have averaged 2½ ozs. of gold per ton. There is a great deal of the reef not taken out in the deeper ground to the west of the gully.

Big Exhibition Reef.

This reef, ranging from 2 to 18 inches in thickness, is about 100 feet to the south of the Little Exhibition reef. The country-rock is extremely hard, owing to the close proximity of the granite below. Granite shows in

the Little Exhibition reef adit. This reef has been worked out to the level of the lowest adit for 200 feet to the west and for several hundred feet up the slope by means of adits to a less depth. There still remains a great deal of the reef at the lowest adit level not worked. Below the adit levels nothing has been done on either reef, and a shaft should certainly be sunk on the western side of the gully, so as to test both of these reefs lower down. On the eastern side of the gully neither of these reefs has been traced; it is highly probable that the gully marks a line of fault and displacement.

The Great Eastern Reef.—The Blue Leader.

Further northward from the Exhibition adits in the gully on the eastern slope of the hill is the Great Eastern reef, from 2 to 18 inches thick; also the Blue Leader, 2 inches thick. Both of these had crushings taken from them, which are reported to have yielded from 1 oz. to $2\frac{1}{2}$ ozs. of gold per ton.

R. Pini's Leader.—Joy's Leader.

R. Pini's leader, 2 inches thick, and Joy's leader, 3 inches thick, were also worked to the northward from the Exhibition reefs.

Perseverance Reef.

One mile N.W. from the Exhibition reefs is the Perseverance reef, a flattish quartz vein, a few inches thick, in granite. 300 tons of quartz from this reef are said to have been crushed for a yield of about 1 oz. of gold per ton.

Information concerning these auriferous quartz veins was given me by Mr. Joy, who accompanied me to the Exhibition reefs.

This is a very favorable tract of country for the prospector and miner, and is well worth attention.

[*Report sent in 5th April, 1906.*]

WOLFRAM AT MT. MURPHY, BUCKWONG RIVER, COUNTY OF BENAMBRA.

(NO. 18 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Mt. Murphy lies about 17 miles N.E. from Mr. Pendergast's Mt Leinster Station, near Omeo. It is on the Buckwong River, near the junction with Mt. Murphy Creek. The present approach is by means of a bridle track, and everything is packed in and out on horseback. A practicable road for wheel traffic is said to be possible on the north-western side of the mount, and if any mining operations are undertaken the clearing of such a road should be a preliminary. Fenced grass paddocks extend within 3 or 4 miles of Mt. Murphy. On the south-eastern foot of the mount is a stockman's hut, and also a prospector's hut.

Mt. Murphy rises to a height of about 4,500 feet above sea-level. On its eastern side there are granitic rocks extending nearly to its summit. The top of the mountain and the western slopes consist of altered sandstones that are very micaceous in places. The wolfram so far discovered has all been within the metamorphic area. Scattered fragments of quartz with a little wolfram disseminated through them, and in some cases pieces of wolfram weighing a pound or more, have been picked up on the top of Mt. Murphy, and on the upper slopes.

Brookfield's Lease.

On this lease the only lode so far discovered occurs on the western side of the mountain, 300 feet below the top. The lode, so far as disclosed, consists of a quartz vein ranging from 1 ft. 3 in. thick at the northern end to 2 ft. about the middle, and 1 ft. 6 in. at the southern end. The wolfram occurs in pieces ranging from the size of a pea to that of a walnut and even larger, scattered through the quartz, more sparsely in some portions than in others. The lode has been traced for a length of 3 chains, and appears to extend still further, both north and south. Only three small cuts have been made into the lode, from each of which about 2 cubic yards of material have been removed. The strike of the lode is N. 30 deg. E.

Evidently no effort has been made to prove the value of this interesting discovery. As it stands this wolfram lode is certainly the best that is known in the State, and when wolfram is at anything over £100 per ton it should be profitable to work. The ore must be concentrated on the spot, and to try its value a shaft must be sunk to a depth of 50 feet on the lode. The material won in this manner would furnish a guide as to the average yield of the lode. The quartz would require to be crushed, and the wolfram concentrated. There would be little expense, and no difficulty about this, owing to the high specific gravity of wolfram. The ore could be broken out of the lode and either brought down to the foot of the mount in sleds, or by means of a little tramway, and it could be dressed at one of the creeks. The concentrates could then be bagged and sent to the seaboard for conveyance to Melbourne. Bairnsdale or Mossiface would be the port for shipment.

Wolfram is notorious for the wide fluctuations that take place in its market value, and it could not be profitably worked without special precautions. To successfully deal with this feature it would be necessary to mine the mineral, to cleanly dress it, and then to send it to Melbourne to be stored until the market price advanced to what would be considered a payable one; then the wolfram, being quite ready for market, could be sold. Mining operations should proceed steadily, but the wolfram should not be sold below a profitable figure.

This lode of what is a comparatively rare mineral deserves to be properly opened up, and its value practically tested; but it does not appear to be practicable for a co-operative party of miners, as they would not be able to wait for the rise in value necessary to render their labour profitable. At present the price of wolfram is about £47 per ton, but it rises to over £160 per ton. At the former price the lode could not be worked to profit, while at the latter price it would yield a handsome return (equal to the price of 40 ozs. of gold per ton of wolfram).

I was informed that a sample weighing some hundredweights was despatched by packing it out. The ore broken out must have been very rich to furnish so much. Fragments of quartz containing pieces of wolfram are strewn down the slope below the lode.

There is every reason to expect that careful prospecting would reveal other lodes. On the top of the mountain many loose pieces have been found, but with the exception of a couple of trenches no work appears to have been done with the object of discovering lodes. On some of the surface stones orange coloured tungstic acid was observed—the result of the decomposition of wolfram.

An analysis of the wolfram made at the Mines Department Laboratory gave 70 per cent. of tungstic acid (WO_3).

[*Report sent in 7th March, 1906.*]

GEOLOGICAL NOTES ON THE MITTA MITTA RIVER, NORTH-EAST DISTRICT.

By E. J. Dunn, F.G.S., Director, Geological Survey.

Leases for dredging have been marked out for several miles above Mitta Mitta township. Between the junctions of the Dark River and Wombat Creek with the Mitta Mitta there are a few miners working the alluvial deposits. These alluvial gravels have been deposited at several different periods, but are all auriferous to some extent.

The most recent gravels are in the river bed. From the Dark River upwards there is a considerable fall in the bed of the Mitta Mitta River, and the rocks are exposed along the banks in the bed of the stream. At the end of the dry season the water becomes diminished in volume, and by means of wing dams the stream is diverted, and the crevices right in the river bed are worked. This method of mining has been pursued for over forty years, but there is still a great deal of the bed that would give small wages if the crevices were carefully cleaned up. Formerly rich patches were obtained, and even now some of those working on the river state that they get 2 grains of gold to the dish on the bars in the river. Besides the actual river channel there are alluvial flats along the river course, some of which have been extensively worked, and from which good yields are reported to have been obtained. There are other flats that have scarcely been tested, and these should in parts be worth working. At a higher level there are terraces, often 40 to 50 feet, and sometimes 100 feet, above the water level. They are in many places extensive, and do not appear to have been much tried. Miners state that they all contain a little gold, but that it would be expensive to bring water to work them.

Still higher up—as much as 300 feet above the river bed—alluvial workings have been carried on along the slopes of the hills for the purpose of gathering up the gold scattered over the slopes that has been set free from the old high level Cainozoic river leads. Mr. Forrest has done much work of this character, and he considers there still remains a large area of similar ground. At the upper portion of his workings he has traced the gravel under the basalt, which evidently filled a tributary of the main old lead. This Cainozoic sub-basaltic wash has not been followed beneath the basalt, but as the gold would be far more concentrated there than on the slopes, this work should be done. The wash is very heavy, and there are large boulders to deal with. Where it runs beneath the basalt it is 4 feet in thickness, and is covered by 7 feet of basalt. The floor is the remarkable agglomerate that forms so much of the river bed above Dark River. On the eastern side of the Mitta Mitta River from about $\frac{1}{4}$ mile below the junction of Toak's Creek up to the junction of Wombat Creek, basalt covers the higher portions of the country. It crosses over to the western side of the river a short distance above the junction of Wombat Creek. It occurs on the southern side of Wombat Creek, and for over a mile up that creek.

Between Wombat Creek and Toak's Creek is an extensive tract of Devonian conglomerate. The most western extension is at Limestone Gap. It crosses Wombat Creek a little above its junction with the Mitta Mitta River, and is generally bounded on the south by the limestone outcrops. It occurs as a bluff 200 feet high close to the limestone bluff on the Mitta Mitta River.

On the eastern side of the river the basalt occupies a large area. It appears to have originated to the north of Lake Omeo, and to have

formed along Morass (Murphy's) Creek, and to the west of it across the present course of the Gibbo River and down the eastern side of the present course of the river.

Above the limestone bluff on the Mitta Mitta River sub-basaltic wash is exposed, and there is a thick capping of basalt over it. This wash has not been tested, although it deserves attention. Three miles further down the river, on the eastern side, is an old hut and enclosure; a short distance from this hut and a little higher up, a very heavy wash has been worked to a small extent. The boulders are in many cases over ½ ton in weight, and extremely well rounded. It is evident that a fair amount of gold was obtained or this work would not have been accomplished; but the wash worked is not in its original position; it has slipped down the slope and become commingled with basaltic nodules. An adit should be driven into the gutter at this point, and the wash in its original position should be tested. This is the lower end of the gutter, so that there will be no difficulty as regards water. From the nature of the wash it must be very extensive, and the river which rolled down such boulders must have been a long and powerful stream. The testing of this high-level old lead is a work of great importance to mining, for if the wash contains sufficient gold to pay, work would probably be provided for hundreds of miners. This tract of country requires fuller examination.

Between Dark River and Wombat Creek on the Mitta Mitta, there still remains alluvial ground suitable for individual miners or for small parties, where, at little initial expense, some gold may be won. As such sites are now exceedingly scarce in the State, it seems desirable that this tract should be exempted from leasing, and should be reserved for a class of miners who have great difficulty in finding claims.

The heavy sand found in the river bed above Dark River gave 3 per cent. of monazite and this contained 4.5 per cent. of thoria.

[*Report sent in 23rd March, 1906.*]

LIMESTONE DEPOSITS AT WOMBAT CREEK AND THE MITTA MITTA RIVER.

(NO. 19 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

At Limestone Gap, through which the track over the divide between Toak's Creek and Wombat Creek passes, there is an outcrop of bluish-grey marble or compact limestone, permeated in places by thin quartz veins. This rock is not suitable for ornamental purposes. From the Gap south-eastward to the Mitta Mitta River, other outcrops of limestone occur. The outcrop at the Gap is about 200 feet, both in length and breadth. The limestone appears to dip almost vertically. To the westward and stratigraphically below it, there is a series of sandstones and slates, apparently Silurian. These rocks rise to the west of the outcrop to form a main range that is the northern continuation of the Mount Wills belt of country. An extensive area of Devonian conglomerate occurs, stretches to the east, and appears to lie immediately above the limestone.

A small tributary runs down from the Gap to the Wombat Creek; it is about 1 mile in length. The track follows this and crosses Wombat Creek about 1,500 feet above sea-level. One and a half miles from the Gap, on the southern side of the creek, is another outcrop of bluish-grey compact limestone, about 5 chains long, and about the same width; a little

further on is a very small outlier, less than 1 chain across. A more extensive outcrop, about 30 chains long and several chains wide, is situated 2 miles from the Gap. The limestone is compact and of bluish-grey colour, but the colour is against its use for ornamental purposes. The height is about 1,800 feet above sea-level. About $\frac{1}{3}$ mile up Wombat Creek from its junction with Mitta Mitta River is another small outcrop of similar limestone, and close by is a mass of Devonian conglomerate standing on edge and projecting several feet above the surface, thus forming a very conspicuous object. This conglomerate is apparently just above the limestone as regards age, and it extends away for a long distance to the north from this point. Between this outcrop and the Mitta Mitta River another limestone outcrop occurs.

On the eastern side of the Mitta Mitta River, and 20 chains above the junction of Wombat Creek, which joins it from the west, there is a bold outcrop of limestone, which rises as a bluff directly from the river to a height of about 200 feet. The face along the river bank is about 400 feet wide. Much of the surface is covered with stalactitic material, and portions of the limestone, that appear to be due to secondary deposition of limestone, are impregnated with iron pyrites and copper pyrites. There does not appear to be any defined lode, but certain irregular portions carry the ore. In places the pyrites attains a thickness of 1 inch, but only for 3 or 4 inches in length. Some slight quarrying has been done both on the river face and on the top of this mass, but the appearances do not encourage further prospecting.

In colour this mass is bluish-grey, like the other outcrops. The texture is compact, and it might be utilized if near a centre of population, but its remote situation precludes its use for the present. It would burn into excellent lime, but there is no local demand.

Just to the north of the limestone is a remarkable mass of Devonian conglomerate, which stands on edge and rises as crags for 200 feet above the river. This conglomerate is stratigraphically above the limestone, and appears to be separated from it by calcareous and fossiliferous mudstones. On the southern side of the limestone, and therefore lower in the rock series, are, first, fossiliferous mudstones, then slates and sandstones, all of Silurian age. Fossils were observed in all the outcrops of limestone, and a few examples were secured for identification.

Resting on the upturned edges of the limestone and conglomerate beds are the Cainozoic conglomerates, &c., of an old lead, and, covering this, a flow of Older Basalt. This locality is one that should be carefully worked out, for clear sections showing the relations of the agglomerate, the slates and sandstones, the limestone, and the overlying conglomerate should be obtainable. Mr. W. H. Ferguson, I believe, reported on this limestone, but his report has not been published.

[*Report sent in 29th March, 1906.*]

DANE'S CREEK SILVER-LEAD LODE, NEAR THE MITTA MITTA RIVER.

(NO. 20 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

About 3 miles in a southerly direction from Dartmouth is the site of prospecting operations carried on by Mr. Cotton. The country up to this point from the Dark River consists for 2 miles of agglomerate, then a belt of slate $\frac{1}{2}$ mile wide, and then agglomerate up to the lodes being tested. The height above sea-level at the lodes is about 1,250 feet.

The No. 1, or western lode, consists of a brecciated mass of agglomerate penetrated by quartz veins, or rather the fragments of agglomerate are bound together by the quartz veins. As far as opened up, copper pyrites, zinc blende, galena and iron pyrites occur disseminated through the lode; in places the galena is in pieces exceeding a pound in weight. The lode has been proved for a width of 18 feet from the eastern wall, which dips E., but the western wall has not yet been cut. The top of the lode is covered with alluvial wash, and its course up the hill to the southward cannot be seen for a little distance; further up the hill, however, it appears to have been located by trenching. The strike of the lode is about S. 25 deg. E., and the dip is to the E. At this point, where the lode crosses Dane's Creek, and on the S. side of the creek, an open-cut is being made, and the overburden of alluvial pebbles and boulders is being removed, so as to follow the lode further southward. No. 2 lode is 8 chains further up Dane's Creek. Its strike is about S. 15 deg. E., and thickness about 6 feet. Quartz and black slate form a brecciated lode material, with copper pyrites, iron pyrites, zinc blende, and galena disseminated through it.

A cut has been put in along the lode for about 40 feet in length, and the same characters continue. The level should be run into the hill for 50 feet; then a winze should be sunk for 20 or 30 feet on the lode, and a cross-cut made at the bottom across the lode. This would give some idea of what the lode is like when unaltered, and would afford the means of taking average samples. The present aspect of the lode is sufficient to justify this work being done.

Some years ago an attempt was made to test these lodes, but only in a perfunctory manner. There is a great tract of the agglomerate, which forms the country-rock, and if a profitable lode were located, search for others would be stimulated. Three chains higher up Dane's Creek than the No. 2 lode there is a gossan outcrop in slate on the southern side of the creek. This has not been opened up to a sufficient depth to show its nature. The agglomerate and slate meet close by, but their relations are obscure. About 900 feet higher, on the top of the crest between Dane's Creek and Larsen's Creek, there are outcrops of lode-like material that would be worth breaking into. The Mitta Mitta River lies about $\frac{3}{4}$ mile to the west of the lodes. Present operations should be continued, and £100 or £200 would be well spent in testing the lodes.

[*Report sent in 22nd March, 1906.*]

AURIFEROUS QUARTZ REEFS, LOWER DARK RIVER, COUNTY OF BENAMBRA.

By E. J. Dunn, F.G.S., Director, Geological Survey.

The Struck Oil Reef.

For 3 miles up the Dark River from its junction with the Mitta Mitta, the rock is agglomerate, then a belt of slate appears. At $5\frac{1}{2}$ miles up the Dark River, close to its northern bank, is the Struck Oil reef.

A tunnel has been driven in on the line of the reef from the spur on the side of the river, but apparently little work has been done here. The general bearing of the reef is about N.E., and the country-rocks are favorable-looking slates and sandstones. About 3 chains from the mouth of the adit a fault has disturbed the reef. Two chains further N.E.

another fault has cut the reef and displaced it about 1½ chains. North-easterly from this fault the reef is continuous for about 8 chains. There are three shallow shafts sunk along the course of the reef north of the fault, the deepest being 65 feet, and a tunnel has been driven into the reef along the course of the fault from the western side. Two crushings, 13 tons of ore in all, are said to have been taken out, giving results equal to 17½ dwts. of gold per ton, the gold being worth £3 18s. per oz. This reef, which is 1 ft. 6 in. to 2 feet in thickness, seems to be worth further trial, as it is favorably situated for economical working. It is close to the Dark River, from which power might be obtained, and the ore could be run down the hill to the water. The gold shoots pitch southwards.

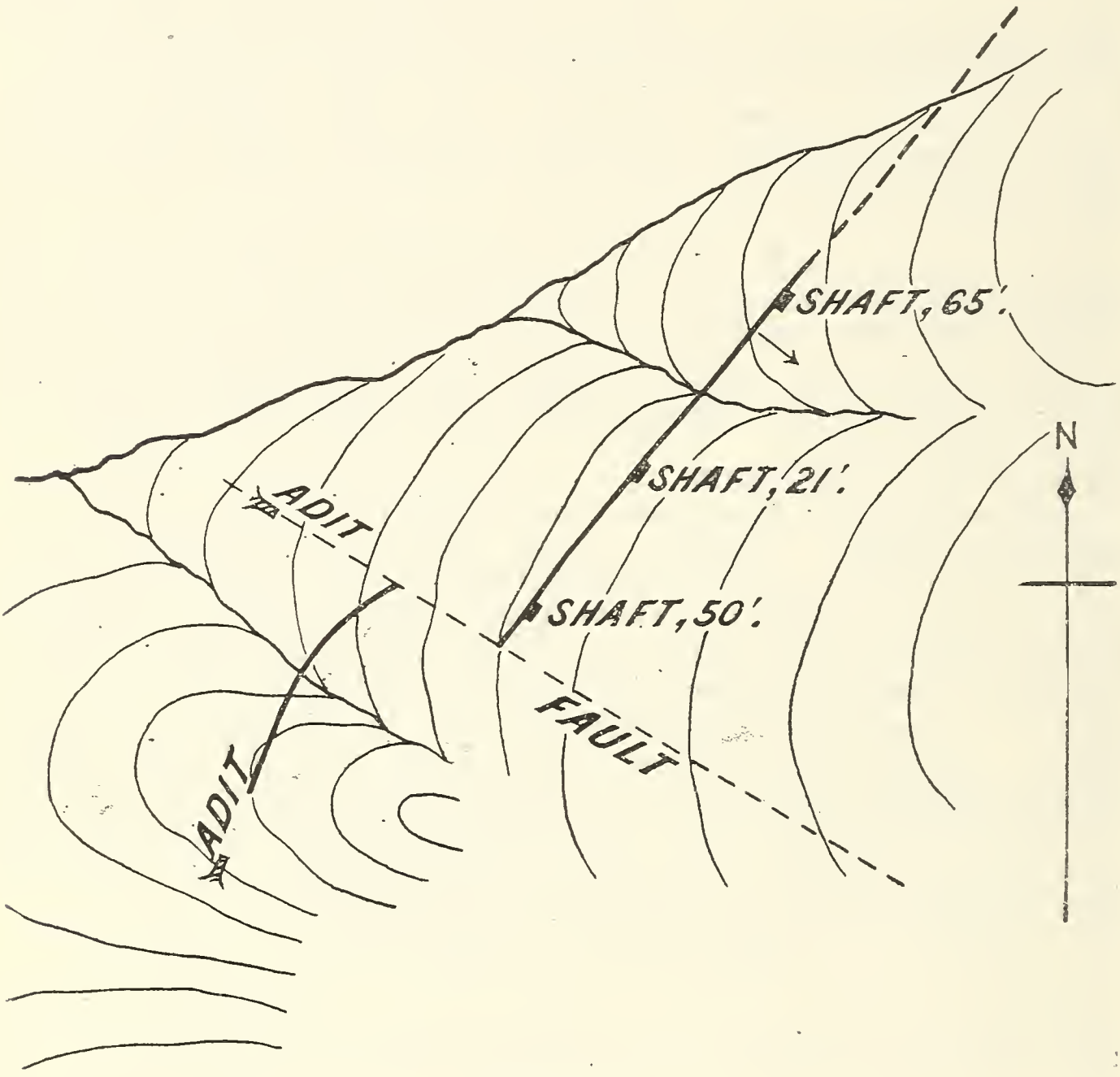

FIG. 31.

SKETCH PLAN OF THE STRUCK OIL REEF.
4 CHAINS TO 1 INCH.

About 3 miles S. 5 deg. E. from the Struck Oil reef is Green's Creek battery, consisting of 10 head of stamps and two boilers. The plant is a good one, but the site is not, on account of the scarcity of water. The crest of the range between Struck Oil reef and Green's Creek battery is 2,500 feet above sea-level, and the altitude of the battery is some 300 feet less. The two localities are on the same belt of slaty country, and this continues further southward. The slates are black and fossiliferous just above the battery site. Agglomerate occurs in the well at the battery, and also in the bank opposite. It seems to be interbedded with the slates, but the relations between the agglomerate and the Silurian slates require to be worked out.

The Golden Eagle Reef.

This reef is ½ mile westerly from the Green's Creek battery, and is reached by a cut track along the hill side. From this track an adit has been driven to the reef, and further up the hill to the south of the track a shaft has been sunk to meet it. The strike of the reef is N.W. The reef is from 9 to 12 inches thick. From the mouth of the adit the reef has been worked for 2½ chains; there a fault was met with, the reef being about 1 chain to the west. A shaft has been sunk on the fault to a depth of 50 feet. At the shaft the reef is much broken up. A considerable quantity of quartz has been crushed from this reef, but the returns were not available. The strike of the country-rocks is N.W., and the dip N.E., at the top of the workings to the south of the track. The height above sea-level is about 2,500 feet.

Sperm Whale Reef.

This reef is 1 mile to the west of the Green's Creek battery, on the same spur as the Golden Eagle reef, but lower down. The country-rocks are the same, viz., slates and sandstones. The strike of the beds is E. 35 deg. S., and the dip westward at 80 deg. The strike of the quartz reef is E. 40 deg. S., and the dip 85 deg. S.W. It ranges up to 2 feet in thickness. This reef has been worked from the surface to a depth of 50 feet, and for a length of 60 feet. At each end, also at the bottom, the reef is cut off by faults. The yield has been from 1½ to 2 ozs. of gold per ton.

The Clara Reef.

About 2 chains to the east of the Sperm Whale reef is the Clara Reef, which ranges up to 2 feet in thickness. Its strike is N. 20 deg. W., and its dip eastward 70 deg. The strike of country-rocks is S.E., and they dip N.E. at 70 deg. The first crushing from this reef, Mr. Murtagh informs me, gave 2 ozs. of gold, worth £3 17s. 6d. per oz., per ton of ore. An adit has been driven from the southern side of the spur to work the reef at a lower level, but very little ore appears to have been broken out. The yields, Mr. Murtagh informs me, were from 1 to 2½ ozs. of gold per ton.

The Commonwealth Reef.

This reef is 2 chains to the north of the Clara reef, and a little to the east of it. It is so much shattered and disturbed that its strike could not be ascertained; but it is probably the northern continuation of the Clara reef. Recently some small crushings were taken out.

The Morning Star Reef.

This reef is about 25 chains S. 30 deg. W. from the Green's Creek battery, and is situated on the western side of the same gully. The reef has been extensively worked from an adit. The height of the mouth of the adit is about 2,700 feet above sea-level. The strike of the country-rocks, which are the same as at all the reefs specified above, is S. 20 deg. E., and they are here tilted up vertically.

About 18 years ago this and several of the other reefs were in full work. From this reef the quartz was conveyed to the battery by a tramway. Below the adit two winzes were sunk to depth of about 40 feet. A long shoot of gold was worked from the surface down to the adit level (over 100 feet in depth), but little effort appears to have been made to prospect below it.

The Bruce Reef.

The Bruce reef occurs 12 chains to the south of the Northern Star reef. It has been worked to a small extent by means of a tunnel and a shallow shaft further up the hill to the west. The strike of the reef is E. 10 deg. N., and the dip almost vertical. The reef is from 1 to 2 feet thick; at the shaft a block of it, 20 feet long and 30 feet deep, has been stoped.

The Lyre-Bird Reef.

This reef, which is about 1 foot thick, lies 1½ miles due south of the Green's Creek battery, on a branch of Larsen's Creek. Its height above sea-level is approximately 2,900 feet. The divide at the crest between the battery and this reef is 300 feet higher. A shaft, 45 feet deep, has been sunk, and here the quartz was stoped for a length of 45 feet. About 3½ chains away, another shaft has been sunk to a depth of 70 feet, and 40 tons of quartz, reported to have yielded 1 oz. of gold to the ton, has been stoped.

The latest crushing was 23½ tons of quartz from the 40-ft. shaft. This yielded, according to the prospector, Mr. Raymond Murtagh, at the rate of 1 oz. of gold per ton. The gold is worth £3 16s. 5d. per oz. It costs 11s. per ton to pack this ore to the battery, which is about 1½ miles distant. The reef continues towards the hill. Some of the first crushings are said to have yielded from 1½ to 3½ ozs. of gold per ton of ore.

The Mountain Gift and White Quartz Reefs.

This reef is about ½ mile to the east of the Lyre-Bird reef, and the White Quartz reef is about 1 mile to the south of the Lyre-Bird reef. Each of these formerly had a battery, and considerable work was done on them, but the batteries have been removed and the mines are deserted. The Mountain Gift reef, Mr. Murtagh informs me, is about 1 ft. 6 in. thick, and it yielded about 1 oz. of gold per ton of ore. The first crushing from this reef is stated to have yielded 22 ozs. of gold per ton of ore, and a large quantity was treated.

McKay's Creek Workings.

About 6 miles eastward from the battery on Green's Creek is McKay's Creek, where reefs were worked for several years. McKay's Creek is a southern tributary of the Dark River. The battery here is idle on account of the cost of crushing the quartz in this remote spot.

Nothing would do more to promote mining in this district, which includes the alluvial resources of the Mitta Mitta River up to Wombat Creek, than a road for wheeled traffic from McMahon's Creek to the Dark River (8 miles) and onwards to the junction of Toak's Creek, about 10 miles further up, or 18 miles in all.

The expenditure of a few hundred pounds would render available a tract of auriferous country that at present is suffering from undeserved neglect. Besides the auriferous tract noticed above, there are others close by that were not visited, but which would be greatly benefited by being made more accessible. The few miners along the Mitta Mitta River have to pack their provisions and tools from 20 to 30 miles, and this is a serious drawback.

[*Report sent in 23rd March, 1906.*]

GENERAL GEOLOGICAL NOTES ON THE COUNTRY BETWEEN OMEO AND LIMESTONE CREEK, COUNTY OF BENAMBRA.

(NOS. 21, 22, AND 23 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Omeo, by aneroid, is about 1,900 feet above sea-level. From Omeo to Benambra Gap the road first passes over granitic rocks, and the highly inclined schists are met with at about 4 miles from Omeo. Benambra Gap is about 2,100 feet above sea-level.

The foliæ of the schist are clearly defined, and it appears to be Silurian rock altered by contact with the granite. At Benambra and around Lake Omeo, which was quite dry at the time of our visit, the schist hills are remarkable for their beautifully rounded outline. From Benambra schistose rocks prevail for about $7\frac{1}{2}$ miles on the road to Mt. Leinster Station, which lies 12 miles E. 38 deg. N. from Benambra. Then granitic rocks continue to within about a mile of the station, where, at the homestead and to the north, a remarkable complex of agglomerate and igneous rocks was examined by Professor Skeats and myself. Some of the igneous rocks are intrusive in the agglomerate as dykes, and others as included masses. Professor Skeats has undertaken the task of describing the extremely varied and remarkable rocks that occur at this place.

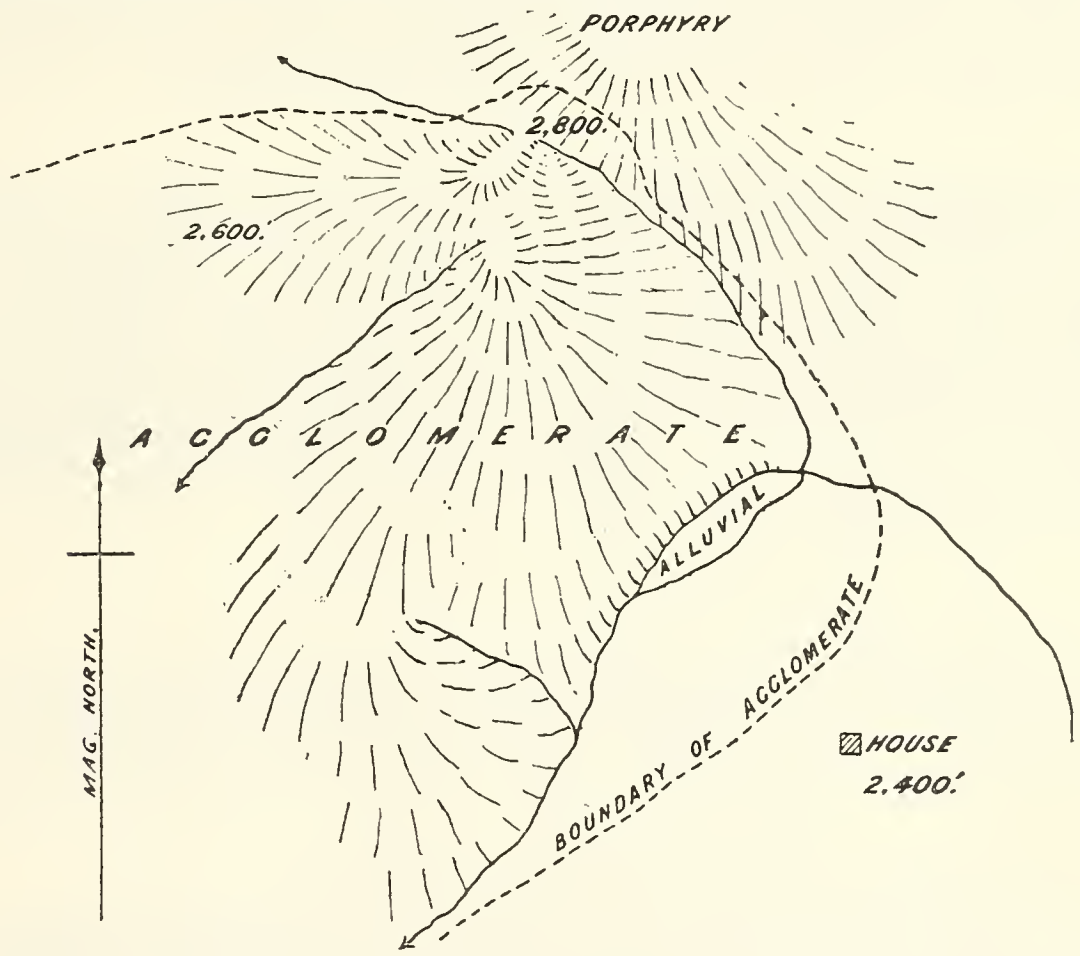

FIG. 32.
SKETCH PLAN OF AGGLOMERATE.
SCALE, 16 CHAINS TO 1 INCH.

From a sketch survey which I made it appears that on the eastern boundary the agglomerate abuts against porphyry, which gives place to granite within a short distance to the east. At the creek near the homestead, the height above sea-level is 2,400 feet, while the height of the highest point on the ridge where the agglomerate and porphyry meet, is 2,800 feet, a vertical height of 400 feet of agglomerate. (See Fig. 32.) No trace of anything like bedding was observed in the agglomerate, which is an indiscriminate mixture of crystalline igneous rock fragments. The

very unusual characters presented here suggest that this may have been a point from which the widely spread agglomerate was ejected. For about 4 miles from Mt. Leinster Station on the road to Limestone Creek the agglomerate rock continues; then granite outcrops. At Marengo Creek there is a small knob with most interesting characters. Syenite and other varieties of allied rocks are here met with. The surrounding rocks appear to be granite, as a little further on ($4\frac{1}{2}$ miles) a creek is crossed, with a good outcrop of normal granite. The granite continues to the Gap between Mt. Leinster Station and Limestone hut. The Gap is 11 miles from the station, and the top is 4,100 feet above sea-level. Slate and sandstone country occurs to the east. There is a strip of serpentine about 10 chains wide near the Gap to the east. Then Silurian rocks (slate and sandstones) outcrop down the northern side of Limestone Creek, with porphyry as well in places. Down the course of the creek alluvial flats open out, bounded by deposits of older gravels (Tertiary). Both in the alluvial wash of the river bed and in the drift of the terraces most of the pebbles consist of felspar porphyry. Along the course of the river for miles a little gold is found both in the terrace drift and in the alluvial wash, and the river course has been marked out for miles under dredging leases. Boring operations are being carried on to test the value of the ground.

Near the out-station hut, alluvial claims have been worked by hydraulic methods, and the ground is said to be payable, but the scarcity of water prevents them from being worked for more than three or four months each year. The height of the hut is 3,200 feet about sea-level.

Victory Copper Lode.

About 4 miles in a south-westerly direction, up the river from the Mt. Leinster out-station hut, is the Victory Copper lode, in Silurian country, which is principally slate. The strike of the lode is E. 10 deg. N., and the dip vertical. The lode, which is 10 feet wide, consists of quartz, partly mingled with calcareous beds, stained with malachite. There is an open trench, about 8 feet deep. A shaft should be sunk here to test the lode to a depth of 20 or 30 feet. Present appearances are not favorable to the occurrence of payable copper ore.

W. O'Rourke's Silver Lode.

About 1 mile to the west of the copper lode is a quartz lode, which is from 3 to 4 feet wide. Trenches have been cut into the hillside, and the course of the lode has been defined. In the quartz are splashes of a dark mineral (a sulphide of some kind). The country-rock is felspar-porphyry.

The Austerlitz Mine.

Mr. D. Toland and another are sinking on an ironstone outcrop on the north-western side of the Limestone Creek, about $\frac{1}{2}$ mile above its junction with the Annabella Creek. The limonite is over a chain in width, and irregular in form. The country-rock is Silurian slate, which strikes E. 10 deg. N., and dips northerly at 65 deg., where the observations were made 10 chains below the top marble outcrop, which latter is directly opposite the Austerlitz mine. A shaft has been sunk here to a depth of 35 feet, but until water-level is reached it will be difficult to know if there is anything of value beneath this "Iron hat." The ironstone is traceable for several chains. The height of the mine is 3,500 feet above sea-level.

The Pender's Reward Mine.

On the north-eastern side of the marble outcrop opposite Stony Creek, on the northern side of Limestone Creek, is Pender's Reward mine. In

this case there is no defined lode, but certain limited portions of the rock have become mineralized, and the silicious material is impregnated with galena and iron pyrites.

The Top Flats Reef.

Three miles N. 40 deg. W. from the hut on Limestone Creek is a quartz reef, on which the Messrs. Pendergast have done considerable work. Three shafts have been sunk, the deepest about 30 feet. The reef varies from a few inches to 1 ft. 6 in. in thickness, and carries a little gold throughout, but so far it has not proved payable. A rich specimen of quartz, 2 lbs. in weight, was discovered here, and this led to the present work, but so far it has been unsuccessful. The country-rocks are Silurian slates and sandstones of a favorable aspect for gold.

(?) Heathcotian.

W. 30 deg. N. $2\frac{1}{2}$ miles from the hut on Limestone Creek is an outcrop of highly silicious schists, permeated by numerous minute quartz veins. The strike of the schists is N. 30 deg. E. These beds bear a strong resemblance to the Heathcotian series.

About half-a-mile to the east of the gap between Limestone Creek and Mount Leinster Station is a small outcrop of serpentine. It is situated near a small creek that crosses the road.

Jaspers.

About 4 miles N. 20 deg. W. from the hut on Limestone Creek near the head of Horse Yard Creek, and at an elevation of 3,200 feet above sea-level, is a band of red jasper rock, interbedded with green schists. These and grey schists form the mass of the rocks. About a mile west from the jasper, an outcrop of steatite occurs in a small creek, about 15 chains above its junction with Middle Creek, into which it runs from the south. The outcrop is less than $\frac{1}{2}$ chain across, and is not traceable for any distance.

[*Report sent in 23rd March, 1906.*]

MARBLE DEPOSITS AT LIMESTONE CREEK, COUNTY OF BENAMBRA.

(NO. 21 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

Limestone Creek flows into the Indi River a few miles to the north of Forest Hill on the boundary between Victoria and New South Wales. The marble deposits are exposed along the course of Limestone Creek for some miles, and are partly on the northern and partly on the southern banks of the creek.

Benambra is the nearest township to the marble outcrops. It is about 2,100 feet above sea-level. From Benambra to Mr. Pendergast's Mt. Leinster Station is a distance of 12 miles in a direction E. 35 deg. N. The height above sea-level is about 2,400 feet. From Mt. Leinster Station to the out-station hut on Limestone Creek is about 14 miles in an easterly direction. The height of the hut above sea-level is 3,200 feet. The marble outcrops extend down the creek from 4 or 5 miles higher up than this hut. The height of the Gap between Mt. Leinster Station and the hut is about 4,000 feet above sea-level, and the road between the two points would have to cross this Gap.

A road that has been partly formed connects Benambra with Mt. Leinster Station, but there is no road for wheeled vehicles between the station and the hut. This road could be made practicable at a moderate cost for summer traffic; but to make a hard road would involve a heavy outlay.

From the marble outcrops to the sea-board the road would pass through Benambra and Omeo, and thence to Mossiface, near Bruthen. The road between Omeo and Mossiface is only made in parts, and is a rough one. There are severe grades, and it would require a very large expenditure to make it hard and smooth. In consequence of these conditions the cost of removing a ton of marble from Limestone Creek to the sea-board will average about £5 in the summer and probably 50 per cent. more in winter, even if traffic for heavy material could then be carried on at all. The road *viâ* Omeo is the only one that could be made available, for down the Indi River the country is reported to be so rugged that there is no hope of removing the marble by a northern route.

Marble Outcrops.

The marble outcrops along the Limestone Creek are lenticular, like most of the limestones in the older rocks of Victoria, and apparently belong to the upper part of the Silurian series. These lenticles vary much in size, ranging from a chain or two in length to 20 or 30 chains. By far the largest outcrop is on Stony Creek, about 3 miles easterly from the hut. The next largest is about 1½ miles in a north-easterly direction from the same point.

The outcrop highest up Limestone Creek is 4 or 5 miles from the hut, just opposite a large outcrop of limonite that is being prospected for silver ore—the Austerlitz mine. The outcrop is a little more than a chain in length, and is unimportant. The height at this point is about 3,500 feet above sea-level. Ten chains lower down the river the slates strike E. 30 deg. N. and dip 65 deg. to the north-west. The limestone and marble deposits in this locality are all associated with Silurian slates.

Following the creek down from this point the next outcrop is met with at the junction of Annabella Creek. It is 6 chains long by 3 chains wide at the widest part. The marble is of a dirty-white colour, but the texture is good, and it might be used for many purposes.

No. 2 outcrop of Mr. Stirling's map comes next. It is a few hundred yards above the hut, and is about 1 acre in extent. The marble is whitish and grey, and does not appear to be of very good quality.

Three hundred yards N.E. from the hut is an outcrop (No. 3 on Mr. Stirling's sketch map). It is narrow and of small area, but contains some small, and formerly beautiful caves, that have been mutilated and wrecked by ignorant visitors. The marble is of a light yellowish-white tint, and is seamed with ferruginous clayey matter, which is made very distinct by the weathering of the more soluble carbonate of lime. The general strike and dip of these clayey seams appears to correspond with those of the adjacent rocks. This area does not present much scope for quarrying marble.

About 1½ miles lower down the creek is No. 4 occurrence of Mr. Stirling. It is an irregular outcrop lying between the Stony Creek outcrop and No. 5 of Mr. Stirling's map. The marble is not extensively exposed. Some parts are yellowish in tint, while others are grey and dove-coloured.

It is, of course, quite possible that the top of a large lenticle might appear at the surface as quite a small outcrop of marble; the small outcrop at the surface may expand below to much larger dimensions, but the only way to test this is by actual quarrying or mining operations.

No. 5 of Mr. Stirling is the second largest outcrop on Limestone Creek. It is on the northern side of the stream, and presents a bold outcrop which rises 60 feet above the creek. The strike of the slate beds in the creek is E. 30 deg. N., and they dip N. 30 deg. W. at 60 deg. This outcrop is probably many acres in extent, but a proper survey would be required to determine its exact extent. In it there are extensive caves with entrances opposite the creek, through which Limestone Creek flows when in flood. In several places, attached to the sides of the caves, there are masses of conglomerate; these were formed when the floor of the caves was at a higher level. Gravel was washed into the cave and cemented into a solid conglomerate by the infiltration of calcareous material, and, at the same time, firmly attached to the walls and floor with which it was in contact. Subsequent erosion has deepened the caves and left the remains of the conglomerate attached to the side, several feet above the present floor.

The marble of this outcrop is of pale and darker grey, dove colour, yellowish-white, &c. It appears to be compact and free from fissures or cracks over considerable areas. This side is suitable for quarries, and large blocks of solid marble could be obtained. The material could be worked economically from the face. There is abundance of material disclosed above water-level, and probably much more buried underground at this outcrop.

A little lower down the creek there are two small outcrops (Nos. 6 and 7 on Mr. Stirling's map), which consist of hard bluish-grey marble, but they are not of much consequence. Still further down the creek (about 1½ miles) is No. 9 of Mr. Stirling's map. This is a much larger outcrop similar in character to Nos. 6 and 7, but the material is not of great value.

Stony Creek Marble.

By far the largest and most important outcrop is the deposit at Stony Creek. Altogether it probably covers an area of between 30 or 40 acres. It is divided into three portions by two bands of ash or porphyritic material. The marble is very massive, and appears to be very solid underneath. There is a general absence of swallow-holes and other indications usually present when the limestone is cavernous below. Much of the marble is very massive, but towards the northern end of the outcrop, where quarries have been opened on the eastern bank of Stony Creek, there is a greater tendency to bedding.

This is decidedly the most favorable site for working the marble, as the quality is apparently equal to the best of the other outcrops, and, in addition, there is a greater variety of colour and of markings. Near the northern end at the quarry there are marbles with pale-pink markings, and also with pink and green markings. There is a wide area of dull yellowish-white marble on the western side, and in the central portion also; much of this whitish coloured marble has a reddish mottled appearance, and would probably cut into a useful material. Further southward the marble is greyish.

On the extreme western edge of the outcrop there is a deposit of breccia, in which the fragments are red, and red and white, or white mottled with red. This stone has been formed by the fragments of original marble becoming agglutinated through infiltration of calcareous material. It is a handsome ornamental stone, but there appears to be only a few cubic yards of it. Possibly there are other similar rocks, but none were observed except at the one spot.

Several hundred pounds were expended many years ago by the Pentellic Marble Company in an endeavour to utilize the marble of this

outcrop, but the result was unsatisfactory. At this site there is abundance of marble of good quality suitable for the decoration of houses, and many other purposes. The very fine saccharoidal varieties of white marble were not observed, and probably do not occur. If this deposit at Stony Creek were within easy distance of the sea, or of a railway line, it would be extensively worked. Being in this extremely remote corner of the State, the transport by land is a severe handicap, and the cost of placing rough blocks in Melbourne under existing conditions would greatly exceed the price per ton at which European marbles could be landed there.

This marble forms a portion of the Silurian series, and it is interesting to note near the quarry how the slate beds give place to mudstones that are at first thinly studded with fossil remains. These become more plentiful as the beds rise in the series, and then the marble beds supervene. Above, the marble beds alternate with highly fossiliferous calcareous beds, and then these calcareous beds alternate with mudstones and grits thickly studded with fossils. As the beds rise higher in the series the fossil remains become scantier.

Below the horizon of the quarry are fossiliferous mudstones; then lower still slates, and apparently still lower the marble deposit, which is so extensively developed here.

A little to the north of the quarry, in the bed of Stony Creek, the strike of the mudstones is E. 30 deg. N., and they dip N. 30 deg. W. at 27 deg. The height of the quarry is about 3,100 feet above sea-level.

The principal caves are likely to be found in the No. 5 outcrop on the northern side of Limestone Creek, and exploration would probably result in the discovery of other small caves in the outcrop near the hut on the southern side of the creek, but with the exception of one or two small depressions in the surface at the Stony Creek outcrop there was scant evidence of the existence of caves.

Professor Skeats and Mr. Summers, the sculptor, were with me when the examination of these outcrops was made. Mr. Summers was indefatigable in testing the qualities of the stone, and can speak with confidence as to its value for various purposes.

The visit was a brief one, as provisions had to be packed in. As the proper detailed examination requires much more time to be spent on the ground, it is intended to send a geological officer and party to thoroughly survey all the outcrops, to show their relations to the surrounding rocks, and to fix their positions relatively to one another; also to secure as great a variety of samples of marble as possible, together with typical fossils.

These deposits have been reported upon by Dr. Howitt in Prog. Rept. Geol. Surv., Vic., No. III., 1876, p. 195; and by Mr. Jas. Stirling, in the Quarterly Report, Department of Mines, Victoria, 30th September, 1889.

[*Report sent in 28th March, 1906.*]

THE COAL CREEK MINE, KORUMBURRA.

(NO 24 ON LOCALITY MAP.)

By E. J. Dunn, F.G.S., Director, Geological Survey.

While at Korumburra selecting a site for coal boring in the vicinity, a visit was paid to the Coal Creek mine, and the underground workings. The coal seam is 3 feet thick, with a ½-in. "pricking" near the bottom of the seam, which is soft and useful for holing. The mine is equipped with hauling and pumping plant, tramway several hundred yards long to the railway, &c., and the output is 70 tons of coal per day. Needless to say, such a small output is unsatisfactory when the standing charges would

only be slightly increased if four times the quantity of coal were being hauled. The cost of winning the coal under such conditions is unnecessarily great, and, again, the high price restricts demand. A more vigorous method of mining would give larger profits to the shareholder, better wages to the miner, and still supply the coal at a less price to the consumer. If more extensively bored and larger areas of coal found with seams, even 3 feet thick, there should be room for expansion of the industry on the basis of a lower selling price. It appears highly probable that the coal seams may be far more extensive than so far proved. Much of the country-rock is inclined at considerable angles, but this in itself is no great drawback, so long as the rocks have not been too much broken up.

It would add to the value of the industry if the by-products were utilized. In the older countries brick and tile works, pipe manufactories, and potteries are common adjuncts to coal mines. At Korumburra there are immense deposits of shale in the Jurassic beds, and the coal is generally associated with shales. The shales, by grinding, would furnish valuable clays suitable for many purposes, such as making varieties of bricks, tiles, pipes, stoneware, &c., and, perhaps, also fireclay and other fire-resisting material. Some of these clays vitrify at a low temperature, while others appear to be most refractory. Samples have been secured, and sent to the Laboratory for briquette tests, and also for complete analysis.

The Jurassic rocks are remarkable for the exceedingly fertile soil they furnish when weathered down, and the analysis of the shales should furnish some hints as to the source of this fertility.

At present bricks are brought from Melbourne, heavy freight-charges being added to the original price, while at Korumburra there is superior material on the spot for making bricks and cheaper fuel for burning them in the form of slack. Brickworks at Korumburra could supply a wide radius with all the bricks required, and at a moderate price. Later on pipes, tiles, &c., could also be made.

The results obtained at the Laboratory in testing the Korumburra Jurassic shales for brick-making were very favorable, and showed that an excellent brick could be produced at a low temperature (1150), but that at higher temperatures (1400) it became vesicular.

[*Report sent in 16th January, 1906.*]

ON A TOOTH OF *CERATODUS* AND A DINOSAURIAN CLAW FROM THE LOWER JURASSIC OF VICTORIA, AUSTRALIA.

(NO. 25 ON LOCALITY MAP.)

By A. Smith Woodward, LL.D., F.R.S., of the British Museum.

(Reprinted from the *Annals and Magazine of Natural History*, Ser. 7, Vol. XVIII., July, 1906.)

(Plate XIV.)

The Jurassic vertebrate fauna of the Australian region is still almost unknown, some Ganoid fishes* and, perhaps, a few small Dinosaurian bones† being the only fossils representing it hitherto described. A tooth of *Ceratodus* and a Dinosaurian claw discovered by Mr. W. H. Ferguson in

* A. S. Woodward, "The Fossil Fishes of the Talbragar Beds," Mem. Geol. Surv. N.S. Wales, Palæont. No. 9 (1895); T. S. Hall, "A New Genus and a New Species of Fish from the Mesozoic Rocks of Victoria," Proc. Roy. Soc. Vict. n.s., Vol. XII. (1900), Art. XVI.

† H. G. Seeley, "On *Agrosaurus Macgillivrayi* (Seeley), a Saurischian Reptile from the N.E. Coast of Australia," Quart. Journ. Geol. Soc., Vol. XLVII. (1891), pp. 164–165, with figs.

the Lower Jurassic cliffs of Cape Paterson, on the south coast of Victoria, are thus of special interest. I am indebted to Prof. J. W. Gregory, F.R.S., for the opportunity of studying these specimens.

The tooth of *Ceratodus* (Pl. XIV., fig. 1) is firmly fixed to a recognisable piece of the splenial bone, and is therefore proved to belong to the left side of the lower jaw. It unfortunately lacks the foremost denticle, but clearly agrees with the majority of the Mesozoic teeth of *Ceratodus* in possessing only four denticles altogether. It is thick and robust, with the grinding-surface slightly convex, but wavy, and marked by a very prominent coarse network of ridges (fig. 1). It is specially remarkable for the long and narrow shape of its crown, which is bounded on the inner side by a nearly straight margin, not angulated opposite the second or third denticle. So far as can be determined from a fragment, the foremost denticle of the tooth appears to have been relatively large, while the others rapidly decrease in size backwards. The second and third denticles are sharply compressed to an acute outer edge, and are separated by deep notches at the outer margin (fig. 1*a*), though not continued as conspicuous ridges on the crown. Their long axes are not oblique, but directed nearly at right angles to the inner margin. The fourth or hindmost denticle is comparatively blunt. Fine horizontal lines of growth are seen on the flattened inner (fig. 1*b*) and outer faces of the tooth.

The specimen thus described differs from all the known Mesozoic teeth of *Ceratodus* in its narrowness, combined with the straightness of its inner margin and the direction of its second and third denticles. In these respects, it is interesting to observe, the tooth more nearly approaches that of the existing *Ceratodus* or *Neoceratodus* of Queensland (fig. 2), and its only striking difference from the latter consists in its having four denticles instead of six. The multiplication of the denticles has already been observed in the teeth of certain sharks as they are traced onwards in time* ; the same phenomenon obviously occurs in *Ceratodus*.

There is, therefore, no doubt that the tooth from Cape Paterson represents a new species, which may be named *Ceratodus avus*. The fossil proves for the first time that the remarkable Dipnoan genus to which it belongs had already reached the Australian region so long ago as the early part of the Jurassic period. At that epoch *Ceratodus* was still living both in Europe† and in North America,‡ while it survived in the African and South American regions at least until the Cretaceous period.§

In the same rock as that from which the tooth of *Ceratodus* was obtained at Cape Paterson Mr. Ferguson found the terminal phalangeal bone shown in fig. 3. Among Jurassic fossils this specimen can only be compared with the claw of a carnivorous Dinosaur, and there is little doubt that it represents a genus more or less related to *Megalosaurus*.‖ The bone has decayed somewhat in the upper part of its proximal end, but is otherwise well preserved and displays its principal characters. The phalangeal is laterally compressed, so that its greatest transverse diameter is somewhat less than its original depth at the proximal end. The distal tapering half of the bone is only gently curved downwards, but at the same time bends slightly to the left side. The distal half of the lateral face is marked with the usual deep longitudinal groove connected with the fixing and

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* A. S. Woodward, "On the Palæontology of the Selachian Genus *Notidanus*, Cuvier," Geol. Mag. [3] Vol. III. (1886), p. 257.

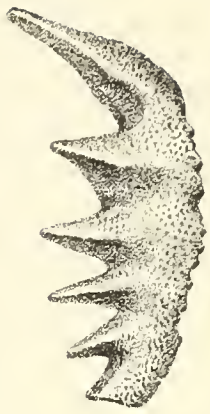
† *Ceratodus Phillipsi*, Aggassiz. "Rech. Poiss. Foss.," Vol. III. (1838), p. 135, pl. XIX., fig. 17 ; A. S. Woodward, Proc. Geol. Assoc., Vol. XI. (1890), p. 292, pl. III., fig. 5.

‡ *Ceratodus Guentheri*, O. C. Marsh, Amer. Journ. Sci. [3] Vol. XV. (1878) p. 76, woode.

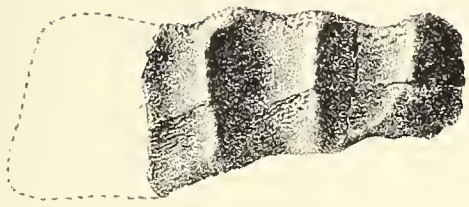
§ *Ceratodus africanus*, E. Haug, "Comptes Rendus.," Vol. CXXXVIII. (1904), p. 1529 ; from Djoua, Timassânine, Sahara. *Ceratodus Iheringi*, F. Ameghino, Public. Univ. La Plata, No. 2 (1904), p. 10, fig. 1 ; from Patagonia.

‖ R. Owen, "Fossil Reptilia of the Wealden and Purbeck Formations," Pt. III. (Mon. Palæont. Soc. 1855 [1857]), p. 19, pl. X.

2 a.



2.



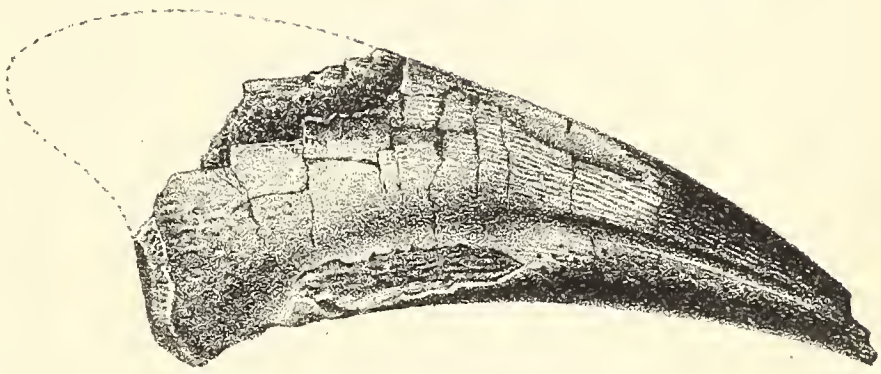
1a.

1.

spl.

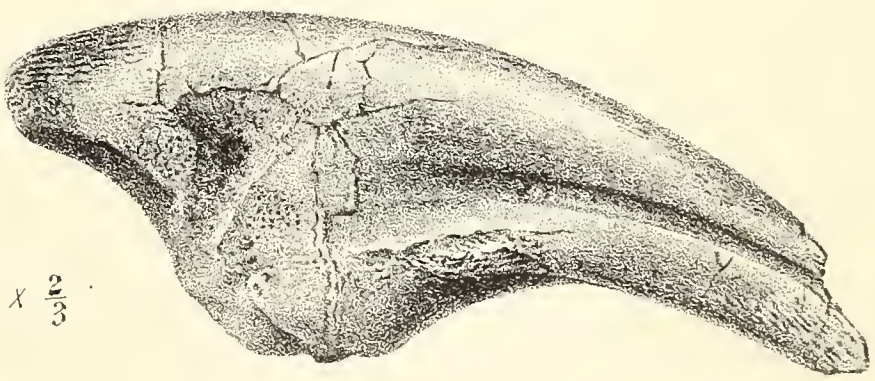
1b.

3a.



3.

4a.



$\times \frac{2}{3}$

4.

J. Green del, lith et imp.

1, 2. CERATODUS TEETH. 3,4. MEGALOSAURIAN CLAWS.

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NATURAL HISTORY

nourishment of the horny claw which originally ensheathed the bone. The proximal end (fig. 3*a*) is divided as usual by a median vertical ridge into two facettes, which are nearly flat. For comparison with this specimen one of the finest known Megalosaurian claws from the English Wealden is shown in fig. 4. The latter is shorter and stouter than the former, and its deep lateral groove extends further backwards; but the general resemblance between the two fossils is very striking.

It is to be hoped that further diligent search may be made at Cape Paterson to recover the vertebrate fauna indicated by these fragmentary fossils. The discovery of the terrestrial and freshwater life of the Australian region during the Jurassic period would supply a most important deficiency in palæontological knowledge.

EXPLANATION OF PLATE XIV.

Fig. 1. *Ceratodus avus*, sp. n.; left splenial with lower tooth, from the upper, outer (*a*), and inner (*b*) aspects.—Lower Jurassic; Cape Paterson, Victoria, Australia. *spl.*, splenial bone.

Fig. 2. *Ceratodus Forsteri*, Krefft; left lower tooth from the upper and outer (*a*) aspects.—Recent; Queensland.

Fig. 3. Ungual phalange of carnivorous Dinosaur; lateral and end (*a*) views.—Lower Jurassic; Cape Paterson, Victoria.

Fig. 4. Ungual phalange of a Megalosaurian; lateral and end (*a*) views, two-thirds nat. size.—Wealden; Sussex. [Brit. Mus., no. R. 3176.]

Figs. 1-3 are of the natural size.

REPORT ON GRAPTOLITES.

By T. S. Hall, M.A. (Melbourne University).

(Nos. 1178-1406. Collected by W. H. Ferguson.)

From Dunolly. 51½ *chains north of the north corner of allot.* 18, *sec. xi., parish of Painswick.*

Though this large series of specimens, collected by Mr. W. H. Ferguson, is for the most part fragmentary and ill-preserved, yet sufficient are identifiable to enable the age of the beds to be determined.

List of species:—

Bryograptus sp., Nos. 1229 (?), 1393 (?).

Clonograptus rigidus var. *tenellus*, Linnarson. Nos. 1183 (?), 1185, 1201 (?), 1221 (?), 1222, 1227, 1261, 1299, 1300, 1311, 1335, 1353, 1385.

Clonograptus rigidus, J. Hall, Nos. 1270, 1724, 1291, 1366.

Clonograptus magnificus, Pritchard, No. 1324 (?).

Clonograptus spp., Nos. 1178, 1189, 1192, 1197, 1199, 1200, 1212, 1218, 1258, 1260 (?), 1275 (?), 1276 (?), 1283 (?), 1290, 1306, 1327 (?), 1330 (?), 1332, 1354, 1356 (?), 1358 (?), 1359 (?), 1363, 1374 (?), 1382, 1388 (?), 1389, 1400 (?), 1404 (?).

Dichograptus sp., Nos. 1301, 1396 (?).

Tetragraptus decipiens, T. S. Hall, Nos. 1223 (?), 1239 (?), 1257 (?), 1263, 1271, 1293, 1294, 1304, 1305 (?), 1308, 1321, 1350, 1362, 1364, 1372 (?), 1387, 1398, 1403 (?).

Tetragraptus sp., Nos. 1226 (?), 1345.

The remaining specimens are not identifiable.

The age of the beds is clearly Lancefieldian, for, in addition to the typical species occurring, there is an absence of Bendigonian fossils. One point may be drawn attention to, and that is that *Bryograptus* is represented

by two doubtful specimens only, though at Lancefield it occurs in profusion. I have seen one specimen from an unknown locality at Bendigo, presumably from a low horizon. *Clonograptus*, on the other hand, ranges, though not common, up into the Castlemaine series. From these facts we may, I think, conclude that the Dunolly beds, as represented in this collection, are slightly younger than the typical Lancefield ones, and are consequently nearer to the Bendigo series in age.

University, 23rd November, 1906.

From Dunolly.

(Collected by Mr. W. H. Ferguson.)

(A) 10 *chains west of peg* 364; Nos. 1050-1066.

Clonograptus tenellus (?), Nos. 1050, 1055, 1066.
Clonograptus sp., Nos. 1051, 1052 (?), 1057, 1059, 1061 (?), 1062, 1064 (?), 1065.
Bryograptus sp., Nos. 1060 (?), 1063.
Tetragraptus decipiens (?), Nos. 1051, 1059.
Indeterminate, Nos. 1053, 1054, 1056, 1058.

(B) 2.6 *chains N.*, 2.3 *chains E., from peg* 415; Nos. 1067-1077.

Clonograptus sp., No. 1069 (?).
Didymograptus pritchardi, No. 1068 (?).
Sponge spicules are shown on No. 1077, but the other specimens are indeterminate.

(C) 3 *chains S.*, 1.5 *chains E., of peg* 409; Nos. 1078-1099.

(?) *Clonograptus* sp., Nos. 1078, 1080, 1089, 1091, 1093, 1096.
No. 1086 is a sponge belonging to the doubtfully valid genus *Stephanella*. Some of the remaining specimens are graptolites, but all are indeterminate.

Like the specimens previously sent by Mr. W. H. Ferguson from this district, they are lowest Lower Ordovician (Lancefieldian). The poor state of preservation of all the specimens makes close determination a matter of difficulty; but, even so, the large series now examined from the neighbourhood of Dunolly enables the horizon to be very closely fixed.

From the Jordan River.

These specimens, collected by Mr. O. A. L. Whitelaw, are from several distinct localities.

(A) *Jordan River*, $2\frac{1}{2}$ *miles above Jericho;* Nos. 1100-1135.

Diplograptus calcaratus, Lap., Nos. 1102 (fig.), 1106, 1108, 1110, 1118 (?), 1122, 1125, 1126, 1127, 1128, 1130, 1132, 1135.
Diplograptus tardus, n. sp., Nos. 1102, 1121, 1129, 1133, 1134, 1135.
Diplograptus spp., Nos., 1100, 1101, 1104, 1105, 1113, 1114, 1115, 1117, 1119, 1120.
Climacograptus bicornis, J. Hall, Nos. 1102, 1104, 1108, 1109, 1110, 1112, 1124, 1125.
Climacograptus bicornis var. *peltifer*, Lapworth, Nos. 1133, 1134.
Climacograptus sp., Nos. 1105, 1107.
Cryptograptus tricornis, Carr., Nos. 1127, 1128.
Glossograptus cf. *hermani*, T. S. Hall, Nos. 1130, 1132.
Dicellograptus elegans, Carr., Nos. 1127, 1128.

Dicellograptus sextans, J. Hall, Nos. 1108, 1109, 1111, 1118, 1121, 1122, 1123, 1127, 1131, 1133 (fig.).
Dicellograptus sp., Nos. 1112, 1129.
Dicranograptus furcatus, J. Hall, No. 1106.
Dicranograptus ramosus, J. Hall, Nos. 1109, 1112 (?), 1125 var.
Dicranograptus ramosus, var. *longicaulis*, Elles and Wood, Nos. 1111, 1121 (fig.).
Dicranograptus nicholsoni, Hopk., Nos. 1132, 1133, 1135.
Dicranograptus sp., Nos. 1110, 1130.
Dicranograptid (? genus), Nos. 1103, 1114, 1116, 1120.
This fine series of specimens contains two new species, which are described below. The beds are Upper Ordovician.

(B) *Little Jordan Creek, 50 chains above junction with Jordan River;* Nos. 1136, 1137, 1138.

Diplograptus tardus, n. sp., Nos. 1136 (type), 1137.

Dicranograptus nicholsoni, No. 1137.

(?) *Climacograptus* sp., No. 1138.

Age—Upper Ordovician.

(C) *Shine's Gully, 10 chains from Jordan R.; Nos.* 1139, 1140.

Diplograptus, spp., Nos. 1139, 1140.

Age—Uncertain.

(D) *From between Jordan River and B.B. Creek, on spur 30 chains east of west boundary of sheet;* No. 1141.

(?) Algal, 1141.

Age—Uncertain.

Remarks on the Species.

Diplograptus calcaratus, Lapworth.

Plate I., Fig. 1.

(*Diplograptus foliaceus*, Murchison, var. *calcaratus*, Lapw., Cat. West. Scot., Foss., 1876, pl. I., fig. 30.)

Hydrosome parallel sided, with a pointed sicular end. Length, about 50 mm.; breadth, at 15 mm. from sicular, 4 mm., and remaining the same to the antisicular end. Virgula free for more than 20 mm. Virgella 7mm. long. The virgula is not visible in the body of the polypary except near the antisicular end. Two lateral spines given off close to the sicula, and arising from a triangular denticle 1 mm. in length. The spines curve towards the sicula through a quadrant, and are 2 mm. long.

Thecæ, 8 in 1 cm., inclined at 25 deg., overlapping half their length. Aperture perpendicular to axis of polypary, not spined.

I am not sure that the separation of the variety as a species is justifiable, though the tendency of late is, of course, in this direction.

Not previously recorded for Australia.

Diplograptus tardus, n. sp.

Plate I., Fig. 2.

Hydrosome stout, slightly tapering towards the sicular end for about 10 mm.; beyond this it is parallel sided. Length, 27 mm.; breadth, 2.5 mm. Thecæ, 12 in. 1 cm., inclined at about 25 deg. to the virgula. Width of aperture, 1.2 mm. They overlap about half their width and half their length; prismatic, straight. Free virgula, 2 to 3 mm. Apertural spines, 1 mm. Three apertural spines seem to be present, though only two are generally visible, and make with the virgella a four-spined extremity.

As is usual in those species, which were evidently lunate in cross-section with the thecal openings on the concave side, a film of matrix in the hollow above the aperture frequently gives a false appearance of a convex outer margin in place of the really straight one.

Glossograptus cf. *hermani*, T. S. Hall.

Plate I., Fig. 3.

(*See* Rec. Geol. Surv., Vic., Vol. I., pt. 1, 1902, p. 34, text fig.)

Dicranograptus ramosus var. *longicaulis*, Elles and Wood.

Plate I., Fig. 5.

(E. and W. Monog. Brit. Grap., pt. 4, 1904, p. 177.)

The specimen figured has a biserial portion 29 mm. long and bearing about 24 thecæ. The specimen is not well preserved, but the three thecæ adjacent to the sicula on each side appear to be spined, a feature which is absent in the variety as described by its founders.

The variety has not previously been recorded for Australia.

Climacograptus bicornis, J. Hall, var. *peltifer*, Lapworth.

The specimen agrees closely with Lapworth's figure in the catalogue of Western Scottish Fossils, and the variety is new for Australia.

Dicellograptus sextans, J. Hall.

Plate I., Fig. 6.

(*See* Elles and Wood. Monog. Brit. Grap. (Palaeont. Soc.), pt. 4 (1904), p. 153.)

From Thomson River. Quarter Sheet 22, N.W.

(A) *Blazed tree, 23 chains S. of boundary.*

Nos. 1142-1148. Collected by Mr. J. P. L. Kenny.

Monograptus cf. *dubius*, Suess; Nos. 1146, 1148.
Monograptus sp., No. 1147.
(?) Pteropods, Nos. 1142, 1145.
Unidentifiable, Nos. 1143, 1144.
Age—Silurian.

(B) *Spur S.W. of Blaze XIII., Thomson River.*

Nos. 1149-1163. Collected by Mr. A. A. Henderson, B.Sc.

Monograptus cf. *dubius*, Suess, Nos. 1152, 1158, 1160, 1161.
Monograptus cf. *crenulatus*, Tornquist (genus, *Monoclimacis*, Frech.), No. 1156.

Monograptus sp. (colonus group), No. 1159.
Monograptus sp., Nos. 1149, 1153, 1154, 1155, 1157, 1162, 1163.
(?) *Monograptus* or *Cyrtograptus*, Nos. 1150, 1151.
Age—Silurian.

From Walhalla. Centennial Mine, Stringer's Creek.

Nos. 1176, 1177. Collected by Mr. J. P. L. Kenny.

These are quite unidentifiable, and may not even be graptolites.

From Kangerong (E. of Dromana). Bald Hill Quarry.

Nos. 1164-1175. Collected by Mr. A. E. Kitson, F.G.S.

Didymograptus sp., No. 1172.
Tetragraptus quadribrachiatus, J. Hall, Nos. 1164, 1173, 1174.
Tetragraptus fruticosus, J. Hall, Nos. 1165, 1169, 1170, 1173, 1174.
Tetragraptus approximatus, Nicholson, Nos. 1166, 1167 (counterparts). The specimen is larger than any I have seen, the branches being more than 2.5 cm. long.
Dichograptus sp., No. 1169.
(?) *Clonograptus magnificus*, Pritchard, No. 1168.
Lower Ordovician. Lower Bendigo series.

From Bendigo.

These specimens were collected by Mr. H. S. Whitelaw.

(A) *From Lightning Hill, North Bendigo.*

Nos. 1407-1414.

Didymograptus sp., No. 1409.
Tetragraptus quadribrachiatus, J. Hall, Nos. 1410, 1411.
Tetragraptus serra (?), Brongn.

Nos. 1415, 1416, 1417 are mineral specimens.

(B) *Smith-street East, Bendigo, 3 chains from Arnold-street.*

Nos. 1418-1427.

Didymograptus latus, n. sp., Nos. 1425, 1427 (counterparts).
Didymograptus sp.; 1422.
Tetragraptus fruticosus, J. Hall, Nos. 1418, 1419.
Tetragraptus serra, Brongn., Nos. 1420, 1424.
Tetragraptus quadribrachiatus, J. Hall, Nos. 1421, 1423.
Clonograptus (?) *flexilis*, J. Hall, No. 1427.
Indeterminate, No. 1426.

If the determination of *Clonograptus flexilis* is correct, as I consider almost certain, then the beds show an approach to the Lancefield series, and are older than the typical Bendigo series as hitherto dealt with.

Didymograptus latus, n. sp.

Plate I., Fig. 7.

Hydrosome broad and stout. Branches diverging at 180 deg., 2 mm. broad and about 1 cm. long in the described specimen. Thecæ about 14 in 1 cm., inclined at 40 deg., of even width, overlapping about three-quarters of their length. Sicula broad; virgula about 1.5 mm. long.

The great breadth of this species in the sicular region distinguishes it from all others.

Locality—Smith-street, Bendigo (No. 1425). Associated with *Clonograptus* (?) *flexilis* (J. Hall) on the same slab.

Bendigo. More definite locality not given. Nos. 1428-1449C.

Didymograptus sp., Nos. 1436, 1447.
Tetragraptus fruticosus, J. Hall, Nos. 1428, 1429, 1430, 1432, 1433, 1435, 1437, 1439, 1442, 1444, 1448, 1449B.
Tetragraptus quadribrachiatus, J. Hall, Nos. 1434, 1437, 1443, 1446, 1449B, 1449C.
Tetragraptus approximatus, Nich., Nos. 1440, 1446.
Dichograptus octobrachiatus, J. Hall, Nos. 1430, 1436 (6 ex.), 1441 (6 ex.), 1447, 1448.
Goniograptus thureaui, McCoy, Nos. 1431, 1442 (several matted).
Phyllograptus typus, J. Hall, Nos. 1433, 1442, 1448.
Rhinopterocaris sp., No. 1437.
Indeterminate, Nos. 1438, 1442, 1445, 1448.
Lower Ordovician. Bendigo series.

Inkerman. No. 1449A.

The specimen collected by Mr. W. H. Ferguson is so extremely indistinct that no definite opinion can be expressed upon it. The marking is in the form of a Y, with arms about 50 mm. long, and with a silvery sheen suggesting the mineral (Gumbelite ?), which so commonly replaces the graptolite skeleton. There are, however, no traces of any thecæ to be seen. Portions of the huge *Clonograptus magnificus* (Pritchard) are frequently preserved in this manner, no thecæ showing, and it is with a fragment of this species that the present specimen may be compared. If this tentative determination be correct, then the age of the rocks may be Lower Bendigonian, or else Lancefieldian, for the species occurs in both series.

It is perhaps not generally realized that our ideas of the age of the old rocks about Ballarat, and to the westward, are mere guesswork, for we have had no fossils. The present specimen then, though inconclusive, raises hopes that fossils may yet be found.

From Howqua River. Great Rand Mine, near Mount Buller.

Delatite. Collected by Mr. A. M. Howitt.

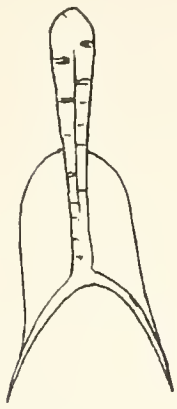
Monograptus sp.; No. 1450.
The fragment is very obscure, but shows the Silurian age of the rock.

From Myrtleford. 10 chains N.E. of Allotment 2, Parish of Myrtleford.

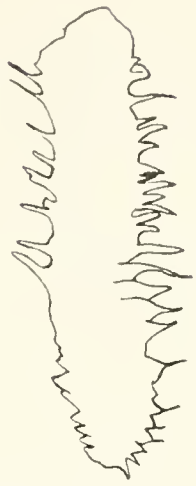
Nos. 1451-1458. Collected by Mr. J. Easton.

None of the specimens are even generically identifiable, but consist of small straight fragments, with one exception. This (No. 1457) appears to show two branches at right angles with each other, as they spring from the sicula. It has straight-sided thecæ, and might be referred to several genera. The thecæ of the remaining specimens are of two kinds, cylindrical and slightly expanding; features, one or other of which are shown on about seven specimens.

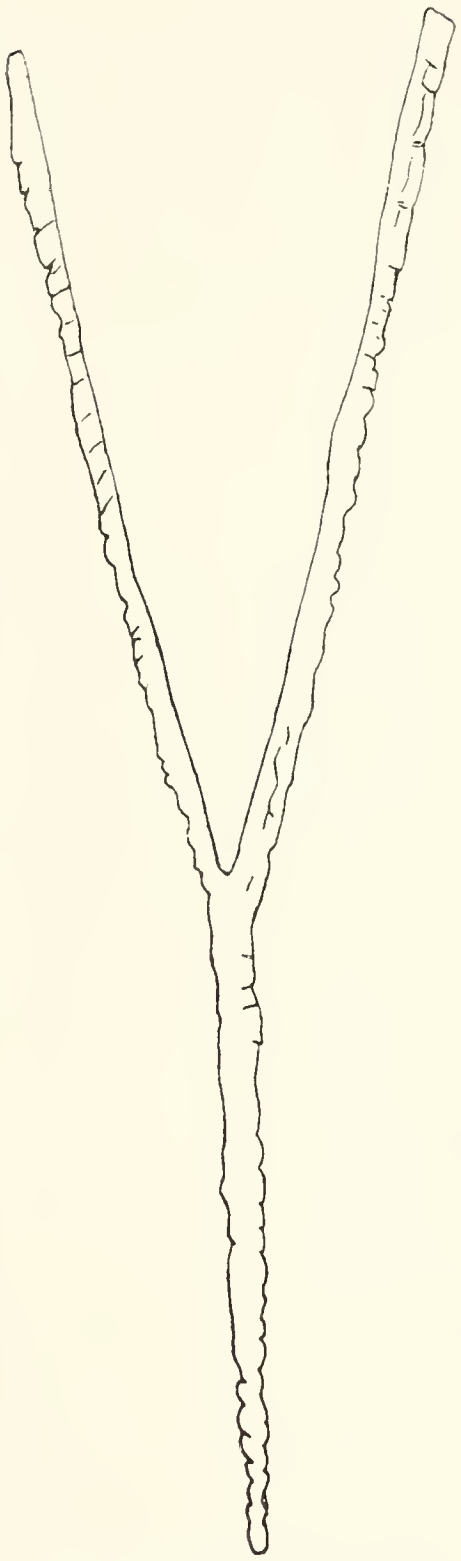
PLATE XV.



4. Climacograptus bicornis
var. peltifer, Lapw.

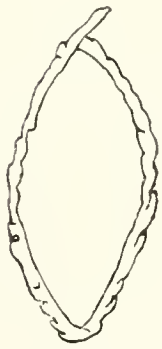


3. Glossograptus cf. hermani,
T. S. Hall.
×2.



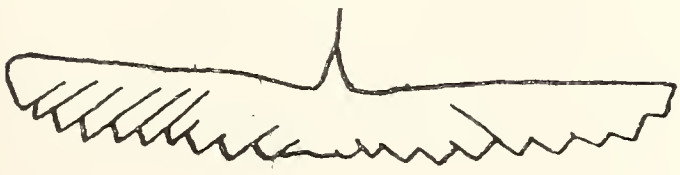
5. Dicranograptus ramosus
var. longicaulis
No. 1121 ×2.

2. Diplograptus tardus n. sp.
No. 1136. ×2.



6. Dicellograptus sextans,
J. Hall.
No. 1133.

1. Diplograptus calcaratus,
Lapw.
No. 1102. ×2.



7. Didymograptus latus, n. sp.
×3.

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In attempting to deduce the age of the beds from these imperfect fragments, we must consider, not only what is present, but also what is absent. In the first place, the fragments are certainly not monograptid, for there is no sign of an embedded virgula in any specimen. Secondly, there are no diplograptids present. The beds then cannot be Silurian, but must be Ordovician.

All the thecæ shown may be referred to the Dichograptidae or other old families. There are no Dicranograptidae present. This fact, supported by the absence of Diplograptidae, points to a Lower Ordovician horizon. If, as seems quite possible, No. 1457 is a Bryograptus allied to *B. victoriae*, then the beds are very low down in the series. There is nothing in the fragments present which would contradict this view, and they might even be compared with forms from this low horizon. However, the material is too poor and fragmentary for a definite opinion to be pronounced, though what there is points to Lower Ordovician.

Of the specimens, numbers 1452, 1454 are doubtfully graptolites; the remainder are undoubted.

University, 14th November, 1906.

PRESENTED
9 MAY. 1908

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By Authority: J. Kemp, Acting Government Printer, Melbourne.

VICTORIA.

NEW SOUTH WALES

SOUTH AUSTRALIA

MILLEWA

Dense Scrubs of Eucalyptus Dumosa

KARKAROOC

WEEAH

Sand Hills & Heath

Dense Scrubs of Eucalyptus Dumosa Mallee

Sandy Desert with Mallee

LOWAN

L. VICTORIA

Wentworth

DARLING R.

Mildura Irrigation Colony

A

B

C

Euston

MURRAY

Balranald

LACHLAN R.

MURRUMBIDGEE R.

Narrandera

Junee

RIVERINA

Moulmein

Tooleybuc

Tyntynder

Castle Donnington

L. TYRRELL

Sea Lake

Boigbeal

Kanyapella

Hopetoun

Coyura

Rosebery

L. ALBACUTYA

L. HINDMARSH

Willenabrina

Jeparit

Brim

Watchem

Wycheproof

Warracknabeal

L. BULOKE

Woorinen

Charlton

Donald

Boolon

Kellalac

Tarkedia

Murra Murra

Minyip

Dimboola

Tarranyurk

Antwerp

Diapur

Lillimur

Miram

Kaniva

Lawloit

Serviceton

Natimuk

Horsham

Wimmera R.

Wallaloo

Burrenbee

Jeparit

Rupanyup

Murtoa

Longerenong

Pimpinio

Jerro

Banyena

Kara Kara

Moyston

Stawell

Great Western

Ararat

Buangor

Ballan

Beaufort

Skipton

Linton

Carngham

Lexton

Clunes

Talbot

Daylesford

Creswick

Ballarat

Buninyong

Scarsdale

Staffordshire R.

Smythesdale

Sebastopol

Learmonth

Mt. Cavendish

Mt. Sturgeon

Mt. Emu

Mt. Jeffcott

Mt. Korong

Mt. Kooyoora

Mt. Wedge

Mt. Tarrengower

Mt. Alexander

Mt. Franklin

Mt. Macedon

Mt. Blackwood

Mt. Egerton

Mt. Bute

Mt. Talbot

Mt. Buangor

Mt. Cole

Mt. Shadforth

Mt. Sturgeon

Mt. Rouse

Mt. Elephant

Mt. Leura

Mt. Noorat

Mt. Napier

Mt. Eccles

Mt. Gambier

Mt. Schank

Mt. Muirhead

Mt. Clay

Mt. Hesse

Mt. Wallace

Mt. Bellarine

Mt. Moorabool

Mt. Misery

Mt. Buninyong

Mt. Warrenheip

Mt. Bolton

Mt. Prospect

Mt. Beckworth

Mt. Greenock

Mt. Bonnie Doon

Mt. Pleasant

Mt. Disappointment

Mt. Slide

Mt. Juliet

Mt. Dandenong

Mt. Macedon

Mt. Aitken

Mt. Holden

Mt. Ridley

Mt. Fraser

Mt. Baw Baw

Mt. Useful

Mt. Tamboritha

Mt. Howitt

Mt. Wellington

Mt. Taylor

Mt. Tanjil

Mt. Worth

Mt. Baldhead

Mt. Strzelecki

Mt. Tassie

Mt. Hotham

Mt. Feathertop

Mt. Fainter

Mt. Loch

Mt. Bogong

Mt. Nelse

Mt. Beauty

Mt. Black

Mt. Back

Mt. Kay

Mt. Cope

Mt. Pilot

Mt. Pinnibar

Mt. Kosciusko

Mt. Tate

Mt. Townsend

Mt. Clarke

Mt. Jagungal

Mt. Selwyn

Mt. Murray

Mt. Ellery

Mt. Darwin

Mt. Stillwell

Mt. Kelly

Mt. Cobberas

Mt. Pendergast

Mt. Delusion

Mt. Cope

Mt. Coonooer

Mt. Korong

Mt. Arnaud

Mt. Cole

Mt. Sturgeon

Mt. Rouse

Mt. Elephant

Mt. Leura

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Mt. Bogong

Mt. Nelse

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Mt. Black

Mt. Back

Mt. Kay

Mt. Cope

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Mt. Tate

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Mt. Clarke

Mt. Jagungal

Mt. Selwyn

Mt. Murray

Mt. Ellery

Mt. Darwin

Mt. Stillwell

Mt. Kelly

Mt. Cobberas

Mt. Pendergast

Mt. Delusion

Mt. Cope

Mt. Coonooer

Mt. Korong

Mt. Arnaud

Tatchera

Gunbower

Ninyeunook

Quambatook

Oakvale

Kerang

Koondrook

Cohuna

Barraport

Barraport West

Bunguluko

Boort

Marmal

Towan Gurr

Wychitella

Buckrabanyule

Barkeake

Kinypanial

Wedderburn

Cape Cope

Coonooer

Gladstone

Bendigo

Sandhurst

Rodney

Nuncia

Daniember East

Rochester

Echuca

Tocumwal

Mathoura

Barmah

Nathalia

Moira

Yarrawonga

Cobram

Bearii

Tulleh

Muckatah

Katamatite

Wunghnu

Bunbartha

Marungi

Tungamah

Kurrabiuet

Karramomus

Numurkah

Dunbulbelana

Petlubella

Peechelba

Mokoan

Thoona

Wangaratta

Oxley

Glenrowen

Winton

Benalla

Creta

Violet Town

Baddaginnie

Tarrawingee

Beechworth

Everton

Stanley

Bruarong

Hillsborough

Myrtleford

Porepunkah

Bright

Bogong

Benambra

Omeo

Bairnsdale

Sale

Maffra

Stratford

Heyfield

Newry

Seaton

Wetkalla

Tambo

Eagle R.

Briagolong

Tanjil

Tanjil Bren

Tanjil South

Toongabbie

Cowwarr

Warragul

Drouin

Buln Buln

Morwell

Traralgon

Flynn

Tarra

Yallourn

Trafalgar

Willung

Longford

Sale

Dargo

Croajingolong

Orbost

Tabara

Buchan

Deptford

Bruthen

Nowa Nowa

Sarsfield

Balmoral

Cann River

Genoa

Mallacoota Inlet

Mallacoota

Gabo Island

Cape Howe

Rendock

Tongio West

Tongio

Numbie

Munjie

Mitta Mitta

Tambo

Nicholson

Lake Tyers

Lakes Entrance

Metung

Swan Reach

Paynesville

Eagle Point

Bairnsdale

Lindenow

Lindenow South

Nicholson

Johnsonville

Wonnangatta

Delatite

Dalhousie

Talbot

Grant

Normanby

Polwarth

Heytesbury

Hampden

Grenville

Villiers

Follett

Dundas

Wannon

Glenelg

Wimmera

Lowan

Horsham

Natimuk

Dimboola

Jeparit

Rupanyup

Murtoa

Longerenong

Pimpinio

Jerro

Banyena

Kara Kara

Moyston

Stawell

Great Western

Ararat

Buangor

Ballan

Beaufort

Skipton

Linton

Carngham

Lexton

Clunes

Talbot

Daylesford

Creswick

Ballarat

Buninyong

Scarsdale

Staffordshire R.

Smythesdale

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Mt. Slide

Mt. Juliet

Mt. Dandenong

Mt. Macedon

Mt. Aitken

Mt. Holden

Mt. Ridley

Mt. Fraser

Mt. Baw Baw

Mt. Useful

Mt. Tamboritha

Mt. Howitt

Mt. Wellington

Mt. Taylor

Mt. Tanjil

Mt. Worth

Mt. Baldhead

Mt. Strzelecki

Mt. Tassie

Mt. Hotham

Mt. Feathertop

Mt. Fainter

Mt. Loch

Mt. Bogong

Mt. Nelse

Mt. Beauty

Mt. Black

Mt. Back

Mt. Kay

Mt. Cope

Mt. Pilot

Mt. Pinnibar

Mt. Kosciusko

Mt. Tate

Mt. Townsend

Mt. Clarke

Mt. Jagungal

Mt. Selwyn

Mt. Murray

Mt. Ellery

Mt. Darwin

Mt. Stillwell

Mt. Kelly

Mt. Cobberas

Mt. Pendergast

Mt. Delusion

Mt. Cope

Mt. Coonooer

Mt. Korong

Mt. Arnaud

Port Phillip Bay

Morningtон

Mornington

Dromana

Frankston

Cranbourne

Berwick

Pakenham

Narre Warren

Hampton

Brighton

Sandringham

Moorabbin

Oakleigh

Dandenong

Lilydale

Yarra Glen

Healesville

Yarra R.

Melbourne

Williamstown

Footscray

Essendon

Keilor

Sunbury

Bacchus Marsh

Melton

Werribee

Geelong

Queenscliff

Point Lonsdale

Portarlington

Drysdale

Clifton Springs

Torquay

Anglesea

Aireys Inlet

Lorne

Apollo Bay

Port Campbell

Princetown

Peterborough

Warrnambool

Port Fairy

Portland

Discovery Bay

Cape Otway

Lighthouse

Cape Schanck

Point Nepean

Western Port

French Island

Phillip Island

Wilsons Promontory

Prom

Boroughs indicated thus, –☆

Scale of Miles

Drawn for photo-zinc by S.B. Bowery at the Royal Lands & Survey Office, Melbourne 1st Jan. 1875.